# A Conceptual Model for Consultant Selection in Saudi Arabia

by

Mubarak Faraj Saeed Al-Besher

A Thesis Presented to the

FACULTY OF THE COLLEGE OF GRADUATE STUDIES

KING FAHD UNIVERSITY OF PETROLEUM & MINERALS

DHAHRAN, SAUDI ARABIA

In Partial Fulfillment of the
Requirements for the Degree of

**MASTER OF SCIENCE**

In

**CONSTRUCTION ENGINEERING AND MANAGEMENT**

December, 1998

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**DECEMBER, 1998**

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COLLEGE OF GRADUATE STUDIES

This thesis, written by **MUBARAK FARAJ SAEED AL-BESHER**, under the direction of his Thesis Advisor and approved by his Thesis Committee, has been presented to and accepted by the dean of the College of Graduate Studies, in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE IN CONSTRUCTION ENGINEERING AND MANAGEMENT.**

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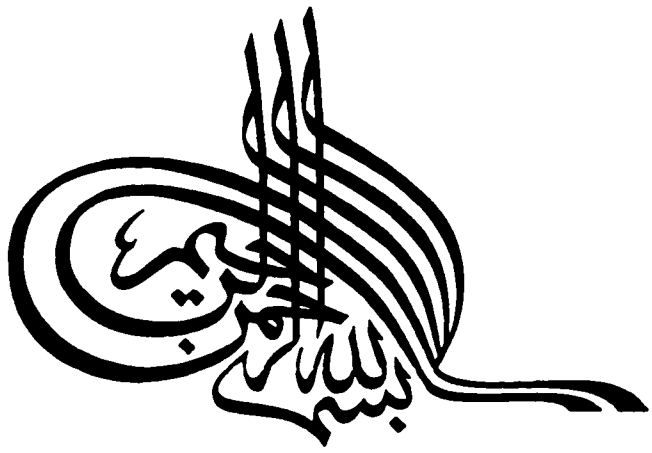
بسم الله الرحمن الرحيم

**This Thesis is Dedicated to the Saudi Consulting Practice.**

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# THESIS ABSTRACT

FULL NAME OF STUDENT: MUBARAK FARAJ SAEED AL-BESHER

TITLE OF THE STUDY : A CONCEPTUAL CONSULTANT SELECTION MODEL (CCSM) FOR A/E SELECTION IN SAUDI ARABIA.

MAJOR : CONSTRUCTION ENGINEERING AND MANAGEMENT

DATE OF DEGREE : DECEMBER 1998

As the public sector considers engaging consultants (A/Es) for professional services, many factors participate in making A/E selection process much inconsistent and complicated. Therefore, the public sector is in need for a consistent, comprehensive and flexible methodology that will ensure successful selection of A/E. This research is directed toward the improvement of the A/E selection process in Saudi Arabia.

Thirty public sector organizations and thirty consultants were surveyed to identify the major selection criteria of A/E. As a result, Work Experience, Project Management, Capability, Staff and Qualification, Quality Performance, Past Performance, Quality Control, References and Firm Capacity were identified to be the major selection criteria. They were used in conjunction with the Analytic Hierarchy Process (AHP) theory concept and a computerized software program "Expert Choice" based on AHP in structuring the A/E consultant conceptual selection model (CCSM). The CCSM was used for solving the selection problem. As results, the (CCSM) model is proved to be practical, complete and flexible enough to meet public sector demand to incorporate any additional criteria.

**MASTER OF SCIENCE DEGREE**

KING FAHD UNIVERSITY OF PETROLEUM AND MINERALS

Dhahran, Saudi Arabia

December, 1998

# خـــلاصـــــة الرســـــالـــــة

اسم الطـــالب الكامل : مبـــارك فـــرج ســـعيد آل بشـــر

عنـــوان الـــرســـالـــة : نموذج لإختيارالمكـــاتب الهنـــــدسية الإستشـــارية للعـــمل مع القطـــاع العـــام في المملكة العربية السعودية.

الـــتخـــصـــص : إدارة و هندســـة التشييد

تـــاريخ الشهـــادة : ديســـمبر، 1998م

حيث أن القطاع العام "الحـــكومي" يقوم بتوظيف المكاتب الهندسية والاستشارية لتنفيـــذ الخدمـــات التخصصية، فإن هنالك العديد من العوامل ألتي تسهم في جعل عملية الاختيار متناقضة وتتسم بالتعقيد. لـــذا فإن القطاع العام بحاجة لطريقة تتسم بالتناسق، الشمولية، والمرونة ليتم من خلالها ضمان نجـــاح عمليـــة إلإختيار. لهذا فانه تمّ تخصيص هذا البحث لتطوير عملية إختيار المكاتب الهندسية والاستشارية في المملكـــة العربية السعودية.

و قد شمل البحث مسح ثلاثين (30) مؤسسة من مؤسسات القطاع العام وثلاثيـــن (30) مكتـــب مـــن المكاتب الهندسية الاستشارية المحلية لتحديد معايير الاختيار الرئيسية، حيث اتضح أن الخبرة العمليـــة، إدارة المشروع، إمكانيات المكتب، الموظفين ومؤهلاتهم، نوعية الأداء، الأداء السابق، المراجع، مراقبة الجـــودة، سمعة المكتب تشكل المعايير الرئيسية للإختيار. و تم استخدام هذه المعايير أو المقـــاييس مقرونـــة بنظريـــة التحليل الهرمي (AHP) و برنامج حاسب آلي "EXPERT CHOICE" تم إعداده على أساس نظريـــــة التحليـــل الهرمي لتكوين نموذجا (CCSM) لإختيارالمكاتب الهندسية والاستشارية و استخدامه لحل مشاكل الاختيـــار. هذا وأثبتت نتائج الإستخدام لنموذج الاختيار (CCSM) انه عملي ومكتمل ويمتاز بالمرونة الكافيـــة لمقابلـــة حاجة القطاع العام لتضمين أى معايير إضافية إن وجدت.

درجة الماجستير في العلوم

جـــامعة الملك فـــهد للبترول و المعـــادن

الظهـــران، المملـــكـــة العربيـــة الســـعوديـــة

# CHAPTER ONE
# THE NEED FOR CONSULTANT'S PRE-QUALIFICATION

# 1 CHAPTER - ONE – THE NEED FOR A/E PRE-QUALIFICATION

## 1-1 Introduction

The launching of the government's massive construction programs (1970-1985) indicated the lack of adequately trained, qualified, and experienced engineers and construction specialists required for the implementation of construction programs. Such construction programs expanded engineering and construction works beyond the public sector in-house engineering and construction responsibilities. The lack of in-house experience forced the public sector to limit the in-house engineer's responsibilities only to contract administration and to seek external professional consultations from the local and foreign consulting firms.

Although, the public sector in-house engineering departments' design capabilities and experience have rapidly improved over the past years as planned by government which recognized the great importance of local A/Es to gain the required experience, yet the needs for specialized A/Es' services have continued. Therefore, the public sector continues to retain and select from the available local and multinational A/Es following inconsistent and unstandrized selection processes. These selection processes are bound by Saudi recruitment regulation {40}.

As the public sector considers selection and engagement of A/E, many factors contribute in making the selection process very inconsistent and complicated. The factors are the large and complex projects, phenomenal technical changes in industries, essence of time, needs for specialized technical expertise, the political needs or legal constraints and the presence of serious problems in many technical areas requiring solutions beyond the capabilities of regular in-house engineers. The above mentioned

factors have necessitated a structured method for selecting the most qualified A/E from the long list containing many A/Es with almost identical qualifications and work experience {5, 37}.

The success of A/E selection process depends on a well-developed methodology based on comparing the selection alternatives in terms of their related criteria. This methodology, if properly conducted, will be an efficient tool to control construction obstacles and to prevent or at least restrict the selection of incompetent, inexperienced and under-financed consultants. It will engage only the A/E that meet the owners' needs through a systematic selection method based on the A/Es professional abilities and technical competence {16}.

Regardless of the public sector managerial capability, the A/E selection process is not an easy task considering the difficult and comprehensive evaluation of related complex criteria. This difficult task exposes the public sector to a multiple criteria decision making problem due to extreme difficulties in defining, evaluating and comparing a number of alternatives (A/Es) competing against each other to win the overall objective of the selection "the award of the proposed project".

Therefore, it is clear that the public sector organizations need to develop a consistent, comprehensive and flexible multiple criteria decision-making model that will solve the consultant's (A/E) selection problem. The proposed model must help systematically pre-qualify, and permit the selection of the most qualified consulting firm (A/E) taking into account related and controlling factors for A/E selection based on ability.

## 1-2 Statement of The Problem

In-house consulting engineers usually provide technical solutions for many problems, and handle many engineering services that are required by the public sector. However, large and complex projects requiring experienced professionals, complex or specialized design requirements and the serious problems in many technical areas are

beyond the capabilities of the regular engineers in the public sector, and the essence of time force owners to secure these services through the procurement regulations. These regulations permit the agencies to engage A/Es to provide the needed professional services according to tendering practice and regulations {23} article 3/t (Appendix-A):

> ***" Consulting services and other services such as studies, drawing up of specifications and supervision of implementation thereof shall be secured through direct purchase if the value thereof does not exceed one million Saudi riyals. If the value exceeds one million riyals, such services shall be secured through the invitation of at least three consulting firms to submit their proposals within a period to be determined by the soliciting agency. The minister concerned shall select the best proposal. Study and design services shall be compensated on a lump sum basis. Supervision services may be compensated on a lump sum or periodic basis or as a percentage of the value of the work to be performed".***

However, the above tendering article and its regulations and implementations clearly leave the proponent agencies unguided to select A/E firms based only upon their own developed and adopted selection criteria. This indicates that there is no consistent approach to prequalify and select A/Es. Proponent agencies performing the A/E selection use different and unstandrized selection procedures without full considerations to professional qualifications. Subsequently, such procedures have limited applications {29, 30}.

This research study will deal with the A/E selection process in an attempt to add to the improvement of the A/E pre-qualification and selection process among public sector organizations in the Kingdom of Saudi Arabia.

Furthermore, the tendering regulations strongly state that ***"The minister concerned shall select the best proposal. Study and design services shall be compensated on a lump sum basis"*** indicating that the A/E with the best proposal should be selected. But selecting engaging A/E with the best proposal may not be easily accomplished because of prevailing competitive practice and general restrictions imposed on the selection procedure based on the lowest fee. This practice automatically excludes the selection of the most qualified A/Es without any consideration paid to their qualifications, and hence financial matters have become the main controlling factors of an A/E selection. This result in low-quality services due to inadequate considerations to assign qualified staff to perform the proposed project {20}.

Therefore, the A/E selection based on this methodology is financially oriented and usually subjected to unfavorable criticism and comments by decision-makers and construction professional {7}.

In Saudi Arabia, there are many factors that contribute to the difficulties of A/E selection. Such factors include circulated directives of the Saudi Council of Ministers numbered M/167/3 dated 27/1/1404H, and 599/17 dated 30/2/1404H (Appendix-A), prohibiting the announcement of the consulting services. Another factor is the increased numbers of specialized local and international A/Es with almost identical qualifications and experience. The use of complex evaluation criteria in a wide variety of pre-qualification and selection processes continues to be a problem to the whole A/E selection process. The above mentioned factors are causing poor A/E selection, resulting in the engagement of unqualified A/E and other disadvantages, such as:

- Low quality of services.
- Poor quality design.
- Inaccurate estimate of construction costs.
- Poor quality of contract documents.

- High prices due to possible pre-arrangement between the A/Es.
- Exclusion of good and experienced A/Es.
- High chance of selecting A/Es with experience and competencies not compatible with the concerned requirements.
- Increased construction and life cycle costs.
- Deteriorated A/E-owner relationship.

Thus, the research seeks to identify a process for the improvement of A/E selection and hence the research problem is stated as follows:

> ***" The development of an A/E consultant conceptual multiple-criteria decision-making model for pre-qualification and selection of A/E is essential for the good of the public sector. The model will assist the proponent agencies to minimize the mentioned problems and ensure the selection of the most qualified A/E who will achieve the desired professional services satisfactory to the public sector objectives " high quality, low costs, and clear time frame."***

## 1-3 Objectives of The Research

In Saudi Arabia, very little research has been conducted in the area of A/E selection, and hence this study will be directed to the improvement of the A/E selection process for the public sector in Saudi Arabia. Previous literature concerning the A/E

prequalification and selection process used by the public sector will be investigated in an attempt to achieve the research's main objectives:

1. ***To identify the selection criteria which are accounted to be the major factors influencing the A/E selection process and determine the best A/E.***
2. ***To develop a conceptual AHP model for solving the A/E selection problem to help the public sector in prequalifying and selecting qualified A/Es "financially capable and technically strong".***

The resulting A/E conceptual selection model **(CCSM)** will be expected to provide the following aids:

- *Introduce the identified A/E selection criteria that will have the most effect on the A/E selection process.*

- *Provide professionals who perform the A/E pre-qualification and selection with a structured and efficient tool for making successful A/E selection decisions.*

- *Help the public sector to solve the selection problems, to avoid dependence on A/E selection based on low bid and to select objectively the most qualified A/Es.*

- *Provide the public sector with a comprehensive and flexible method that will compile the principle criteria suiting the user's needs and will ensure selection of the most qualified A/Es "technically strong and financially capable" to submit their technical proposals for the proposed work.*

- *Provide the owners with a clear understanding of the selected A/E ability, his/her performance to handle the proposed work and what is expected from the selected A/E.*

- *Allow the prospective promoters (A/Es) full and fair consideration.*

## 1-4 Limitations of the Research

The research study is limited to the public sector **(Public agencies)** in Saudi Arabia requiring any of the A/Es' wide professional services.

The study also assumes that members of the public sector selection committee are well trained, experienced, and capable of performing the selection process. They must be briefed on the project's requirements, objectives, selection criteria and procedure to enable them fulfill their duties toward fair and proper A/E selection.

## 1-5 Significance of the Research

Efficiency, convenience and quality of the project are affected by the important decisions that have to be taken at the early stages of initiating the project. A/E selection is one of these decisions that will have an effect on the project's construction stages {8, 43}.

In Saudi Arabia, among the public sector organizations, the selection of a competent A/E firm for the proposed project is a very frustrating procedure and a challenging task. This is due to the many factors influencing the selection process, such as strong opposition to a competitive fee practice as the basis for A/E selection, project size and complexity and the availability of many A/Es with different levels of education, experience, specialization, staffing, design capabilities and management approaches.

Therefore, by conducting this research, main objective of the selection process will be determined and specific A/E selection criteria for the accomplishment of the selection process will be identified. Then the identified selection criteria will be used to develop a comprehensive and flexible A/E consultant selection model (**CCSM**) which will enable the public sector organizations to eliminate the selection of incompetent A/Es. The model will clearly expose the advantages and disadvantages of the selection

alternatives as a result of the comprehensive and conclusive evaluation of as many criteria as specified to ascertain the technical and managerial ability of the A/Es who may submit in their proposals.

## 1-6 Organization of the Thesis

This thesis discusses the A/E prequalification and selection in Saudi Arabia and the identification of the associated important selection criteria which control the selection process and which if not evaluated properly will contribute to poor A/E selection and engagement of unsuitable A/E. Identifying the importance of these selection criteria and developing comprehensive and flexible selection model was an important subject for conducting research that will add to the improvement of the A/E selection process in Saudi Arabia. The nine chapters of the thesis are organized as follows:

**Chapter One:** This chapter gives a general introduction to the need for a consultant selection process in Saudi Arabia, states research problems, set out the objectives, limitations and importance of conducting this research.

**Chapter Two:** It is intended to present a brief look into the Saudi consulting and into previous studies conducted on the A/E prequalification and selection process.

**Chapter Three:** This chapter is devoted to the description of the A/E selection criteria. Three samples of A/E prequalification are also discussed in this chapter.

**Chapter Four:** This chapter is devoted to the explanation of the Analytic Hierarchy Process (AHP). Its advantages, its basic steps, and the Decision Support System (EC) are included.

**Chapter five:** This chapter is devoted to explain of the research methodology.

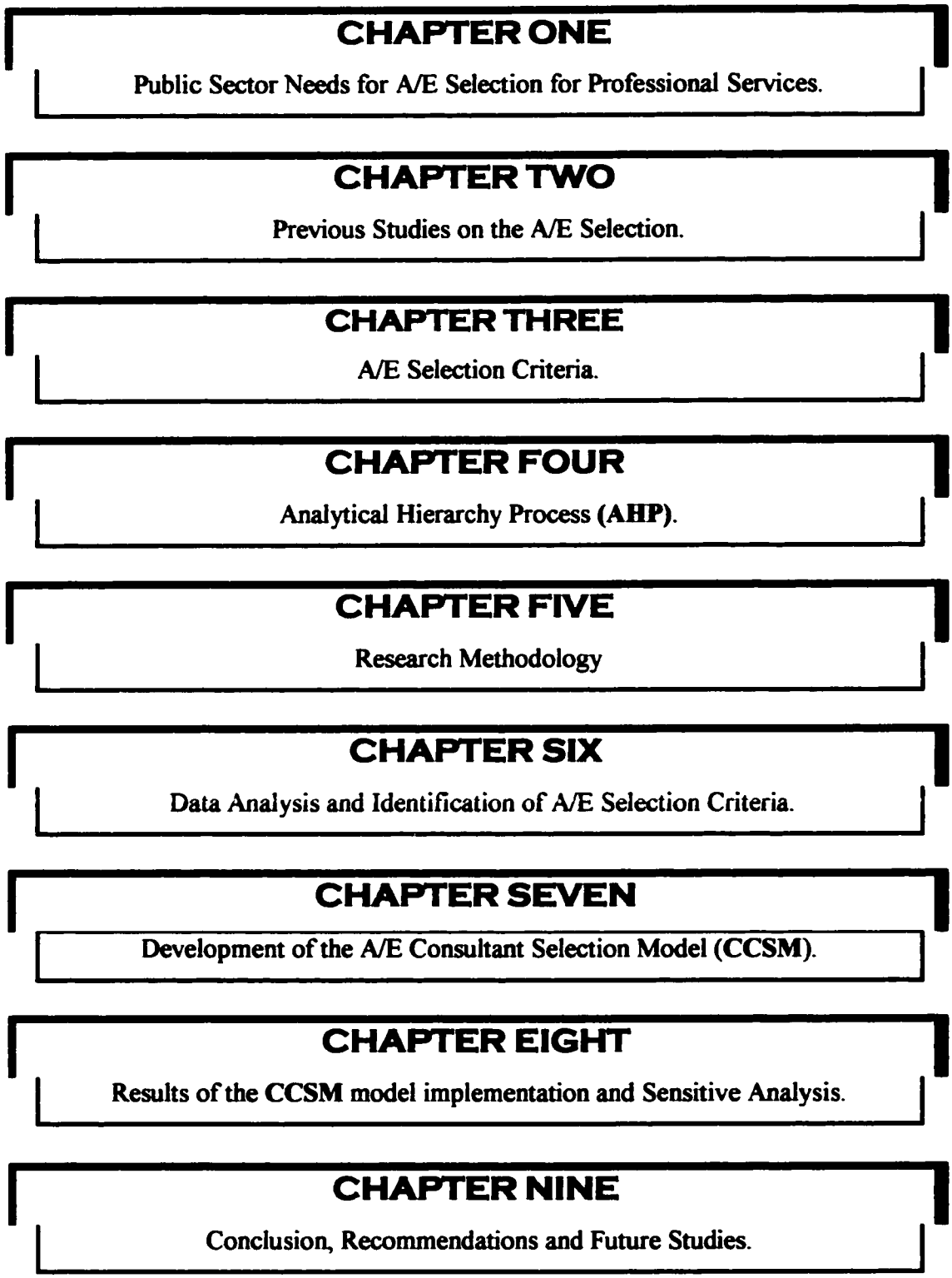
**Chapter Six:** This chapter is devoted to presentation of the analysis of the survey data, the findings and identification of the selection criteria.

**Chapter Seven:** This chapter is devoted to the implementation of AHP theory for the development of the A/E consultant selection model **(CCSM)**.

**Chapter Eight:** This chapter is intended to present results of the implementation and use of the **CCSM** model for the selection of consultants (A/Es) selection.

**Chapter Nine:** This chapter is intended to present the conclusion of the research, recommendations based on the results of research and the implementation of the **CCSM** model, and recommended future studies.

**Figure 1-1** Thesis Organisation Chart



# CHAPTER TWO
# LITERATURE REVIEW

# 2 CHAPTER - TWO – LITERATURE REVIEW

## 2-1 Introduction

The sizes and complexity of construction projects, the high changes in technology in construction industry, the lack of in-house engineering capabilities, the need for specialized technical expertise in both design and construction, the political or legal regulations and the non-repetitive work are all clear factors which compel the public sector to seek the professional services of A/E.

The A/E competency, professionalism and other multi-controlling factors influencing the A/E selection process introduce the owners to a challenging task when the services of A/E are to be retained. Consequently, poor A/E selection occurs when owner's selection committee members do not follow a well-defined selection method.

Regardless of the project delivery system and procurement practice used, the A/E selection through a systematic pre-qualification process has been one of the most important decisions to be taken by the public sector. It has become a mandatory management control step by the public sector in their construction practices. It plays an effective role in the success of the construction phases by ensuring that only competent A/Es are selected to submit proposals for the intended services.

Therefore, the development of the A/E consultant conceptual model (**CCSM**) to deal with multiple criteria would be of great benefit to public sector organizations in solving selection difficulties. It will ensure the comparison of the selection alternatives in terms of exposing their advantages and disadvantages to arrive at selection of the most qualified A/E firm. Such a model will perform a conclusive comparison based on ability with full considerations to the project-related mandatory criteria, and the desired criteria.

## 2-2 Saudi Consulting Practice Review

### 2-2-1 Definition of Consultant

Generally, the consulting engineer is defined as a professional who mainly has to mixed capabilities of practical professional experience and those of a business person who is applying his knowledge in rendering the professional services to the clients in return for money.

### 2-2-2 A Consultant's Clients

Public organizations are the main sources for the projects and hence the A/E' services are in demand among public sector organizations {6}. Regardless of size of the A/E firm, specialty, the form of the organization, the experience and qualification of staffs, the A/E firm renders professional services to any of the following clients:

- Government agencies.
- Private owners.
- Semi-public sector.
- Industry and commerce.
- Other professionals such as lawyers, and to other engineers.

### 2-2-3 Consulting Services

The A/E whose professional experience, technical and specialized services are required in all construction phases can provide professional services depending upon the contractual relationship involved with the clients. However, the A/Es' services may range from the comprehensive services to life cycle costing {6}.

Figures (2-1,2-2,2-3,2-4) show the relationship that could evolve between clients and A/E depending on the type of the delivery systems defined and used by the clients {12, 15}. Table2-1 show the services rendered by the A/E firm.

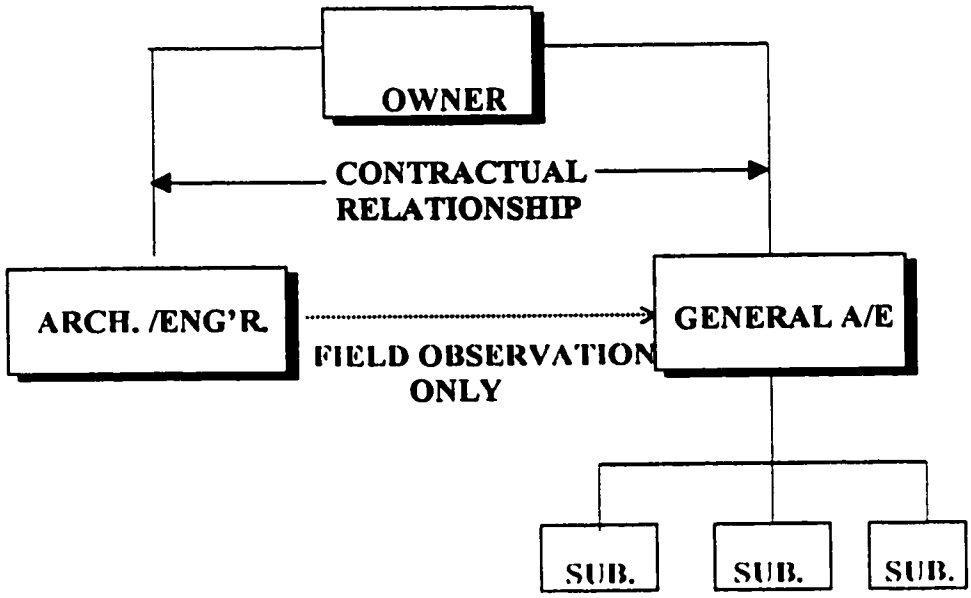



Figure 2-1 A/E-Owner Relationships under Traditional C. Contract

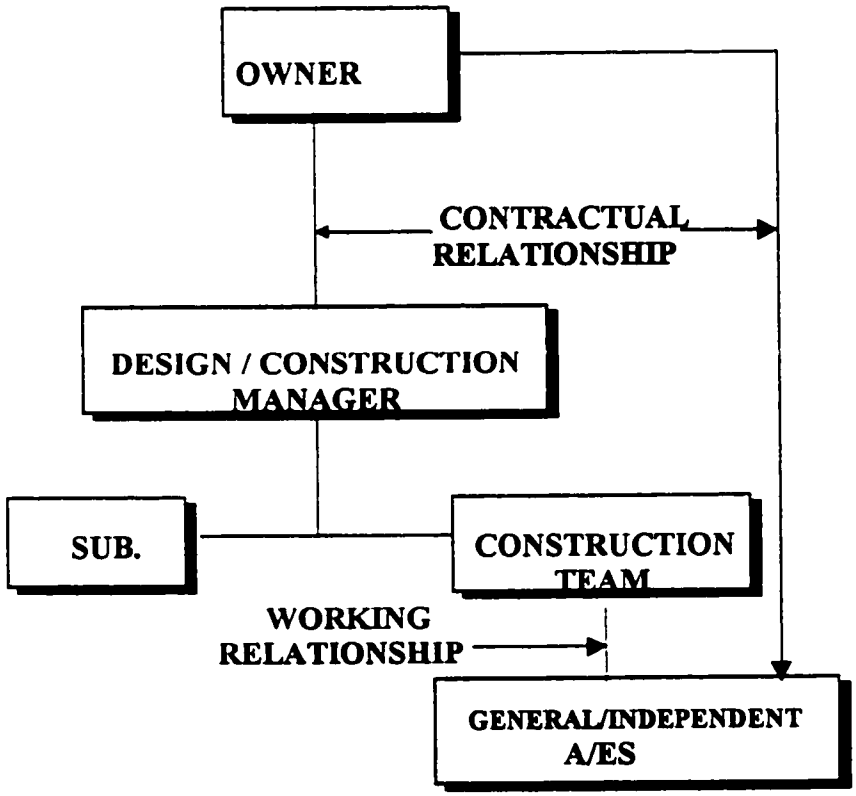



Figure 2-2 A/E-Owner Relationship under Design/Construction Manager Contract.

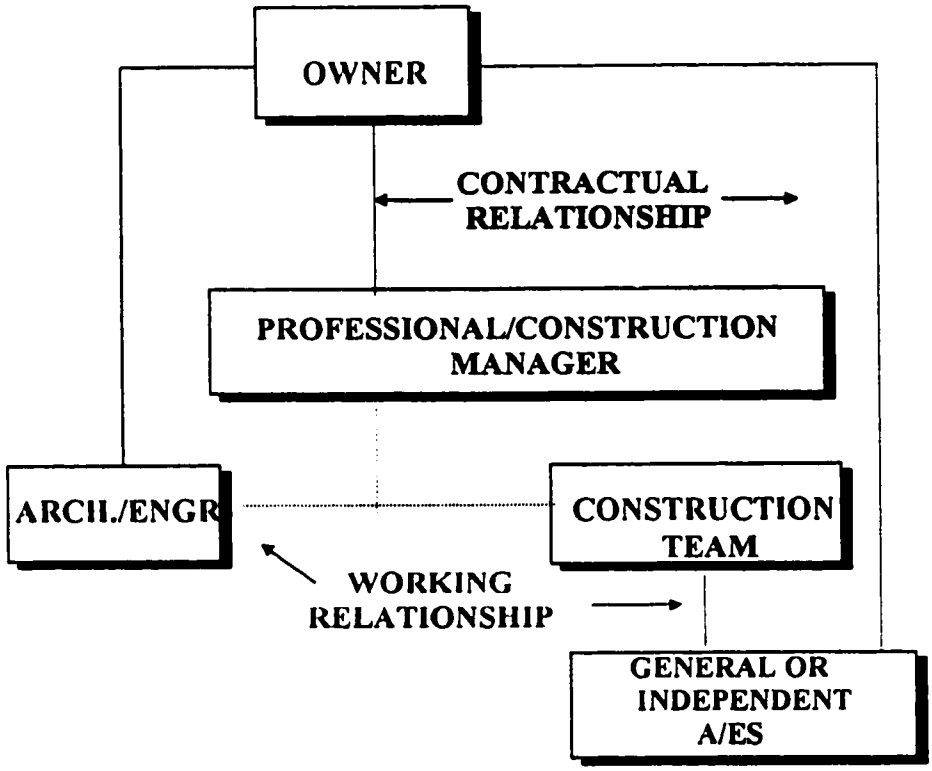



Figure 2-3 A/E-Owner Relationship under a Professional Construction Manager Contract

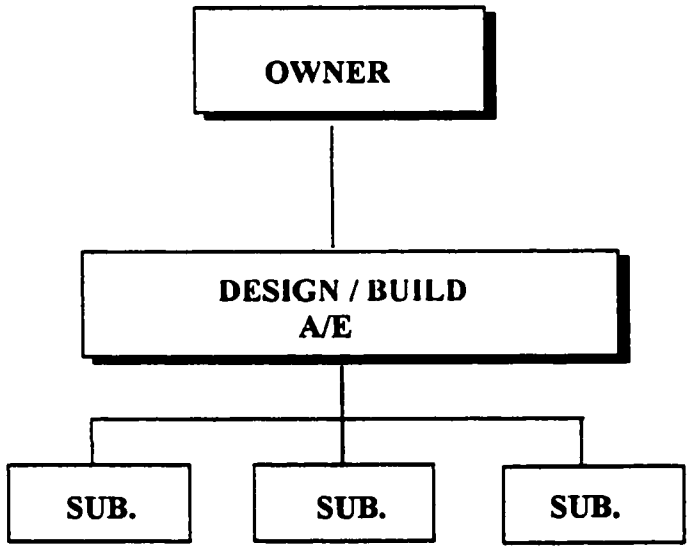



**Figure 2-4 A/E-Owner Relationships under Design/Build Contract.**

**Table 2-1: Services Offered by A/Es**

Source: Al- Musallami 1992.

| |
|---|
| • Comprehensive services. |
| • Basic design services. |
| • Construction management. |
| • Quantity survey. |
| • Feasibility studies. |
| • Budgeting. |
| • Site selection & analysis. |
| • Value engineering. |
| • Marketing studies. |
| • Environmental studies. |
| • Life cycle costing. |

### 2-2-4 The Saudi Consulting Organizations

In Saudi Arabia, the engineering consulting division in the Ministry of Commerce has complete control over the issuance of licenses for the consulting and engineering offices in any part of the Kingdom. The issuance of licenses is restricted to the Ministry of Commerce's identified requirements (Appendix-B).

The types of A/E firms have been divided into Four major categories depending on the owner(s) and the firm(s) nationality (Professions Directory Ministry of Commerce 1414). These major categories are:

- Saudi Engineering Office
- Saudi Consulting Office.
- Non-Saudi Engineering Office.
- Foreign Consulting Office.

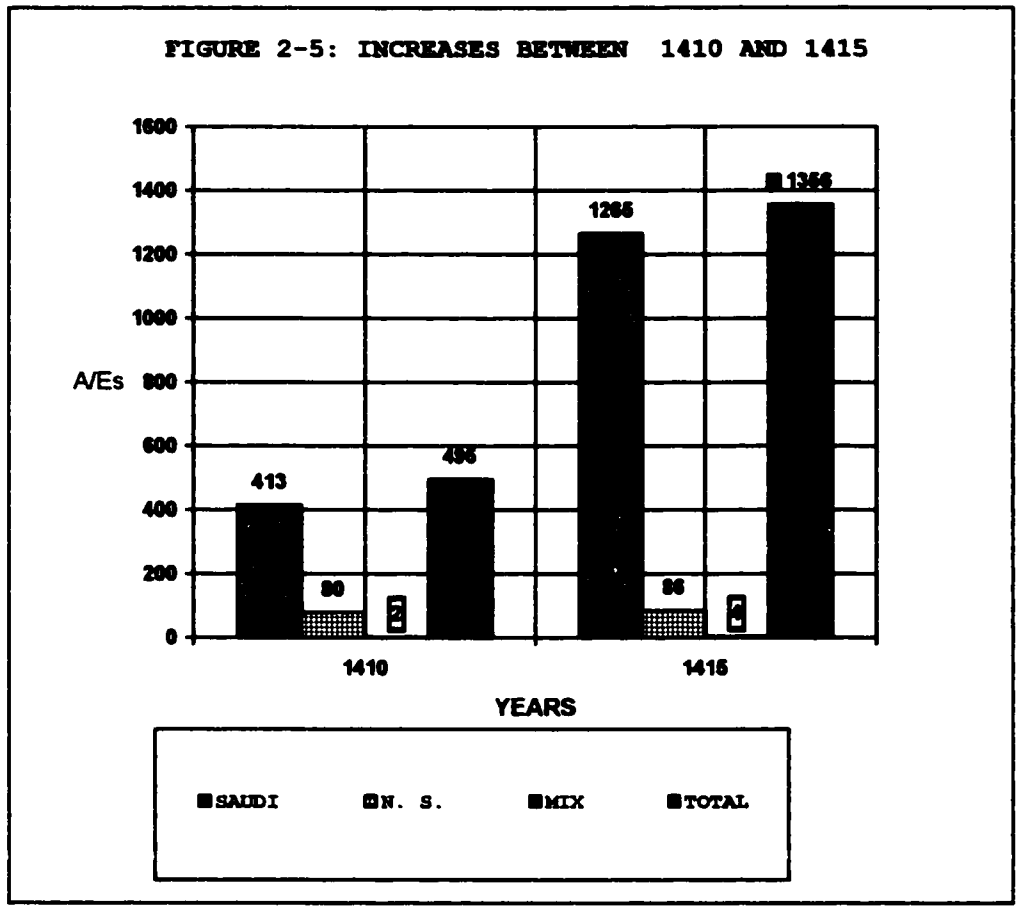
The Saudi consultancy practice, as in other countries, is heading toward specialization {30}. The number of specialized A/Es has increased as stated by Ministry of Commerce officials, and based on comparison between the number of A/E firms from the years 1990 to 1995(1410 A.H to 1415 A.H). The total number of A/E firms registered at the Ministry of Commerce by the end of 1995 is one thousand three hundred and fifty six **(1356)** firms (Statistical years' book issues 1990,1995). Out of which, one thousand two hundred and sixty five **(1265)** are Saudi firms, **(86)** eighty-six are non-Saudi firms, and **(4)** four are mixed firms. Table (2-2) and Figure (2-5) shows the increase in the A/E number.

**TABLE 2-2:** Statistics on Licenses Issued from 1990 to 1995 to Self-Employment Professions

SOURCE: MINISTRY OF PLANNING, "CENTRAL DEPARTMENT OF STATISTICS" STATISTICAL YEAR BOOK ISSUE 31 (1995) AND ISSUE 26 (1990)

| | 1990 (1410 A. H.) | | | | 1995 (1415 A. H.) | | | |
|---|---|---|---|---|---|---|---|---|
| **TYPE OF CONSULTANTS** | **S** | **N.S** | **M** | **TOT** | **S** | **N.S** | **M** | **TOT** |
| ARCHITECTURAL | 111 | 38 | - | **149** | 293 | 38 | - | **331** |
| CIVIL ENGINEERING | 207 | 37 | - | **244** | 383 | 36 | - | **419** |
| DECORATION | 1 | - | - | **1** | 2 | - | - | **2** |
| ELECTRICAL ENGINEERING | 22 | 4 | - | **26** | 43 | 4 | - | **47** |
| ENGINEERING CONSULTANTS | - | - | - | - | 395 | 7 | 4 | **406** |
| ENVIRONMENTAL ENGINEERING | - | - | - | - | 1 | - | - | **1** |
| GEOLOGY & HYDROLOGICAL | 12 | - | - | **12** | 15 | - | - | **15** |
| INDUSTRIAL ENGINEERING | 6 | - | - | **6** | 15 | - | - | **15** |
| MECHANICAL ENGINEERING | 9 | 1 | - | **10** | 29 | 1 | - | **30** |
| PROJECT MANAGEMENT | - | - | - | - | 4 | - | - | **4** |
| REGIONAL & PLANNING ENGINEER | - | - | - | - | 3 | - | - | **3** |
| SOIL PROBING | 6 | - | 1 | **7** | 8 | - | - | **8** |
| SURVEYING | 39 | - | 1 | **40** | 64 | - | - | **65** |
| **TOTAL CONSULTANTS** | **413** | **80** | **2** | **495** | **1265** | **86** | **4** | **1356** |

**FIGURE 2-5** A/Es INCREASING NUMBER BETWEEN YEARS 1990 AND 1995 (1410 AND 1415)



### 2-2-5 The Selection Methods

Regardless of the type of selection methods used, the nature of project, the contract, and owners will always influence the selection methods. However, the best selection method is the one where A/Es are selected on the basis of their professional qualifications and competence. The A/Es' competence and qualifications are evaluated to meet the owner's needs, and to ensure they satisfy the project's specific requirements {3,13,43}.

There are three general selection methods executed considering certain factor(s) that control the selection. They are as follows:

#### *2-2-5-1 Direct Selection Method*

The selection under this method is done on the basis of the A/E reputation, the owner's prior experience with A/E, or a former satisfied client's recommendations. This method is preferred by the A/Es. The owners who prefer this method assume full trust in the selected A/E and the referral selection committee member. This method is disadvantageous to small and new A/Es. It is designed to serve the large and well-established A/E firms rather than the small ones {3}.

#### *2-2-5-2 Competitive Selection Method*

The competitive selection includes selections based on fee and design submissions by A/Es. ***Fee selection*** is controversial and mostly opposed by many officials and design professionals. It requires a clear definition of the needed service, which may be impossible {13, 14}. ***Design competition*** is less controversial than fee competition. It is preferred by A/Es because they are competing in what they do best and only the best will prevail. On the other hand, some A/Es use this method hoping to get away with deceiving the owners with flashy design proposals. Unlike the A/E, owner uses this method just for encouraging new talented A/E, and to get the A/E best effort for the

proposed work {13}. Attracting incompetent and inexperienced A/Es is the one of the method's disadvantages.

#### *2-2-5-3 Comparative Selection Method*

Generally, A/E selection under this method is based on objective evaluation of the A/Es' qualifications and technical experience. It is the most widely used methods. The selection first starts with screening A/Es from a long list (pre-qualification list) of A/Es who submit their qualifications to be prequalified for the proposed project. Usually the submitted qualifications include complete information about:

- List of projects completed by A/E firm.
- Professional experience, training, and education of the key personnel.
- The size and form of organization of the A/E firm.

All A/Es are carefully reviewed and up to five of them are selected to submit technical proposals taking in account the following criteria:

- Experience
- Availability of resources.
- Capacity to complete the work.
- Compatibility.
- Design capability.
- Experience in work of similar size, type and complexity.
- Specialization.
- Office location of firm.
- Professional standing.

The final A/E selection will be based upon the outcome of evaluating the above and possessing a good standing in technical competence, professional experience, business capacity, creativity, and ability.

The two-envelop system is used mostly for engaging the international A/Es. The system requires the A/E to submit two envelopes, which the technical proposal is in one

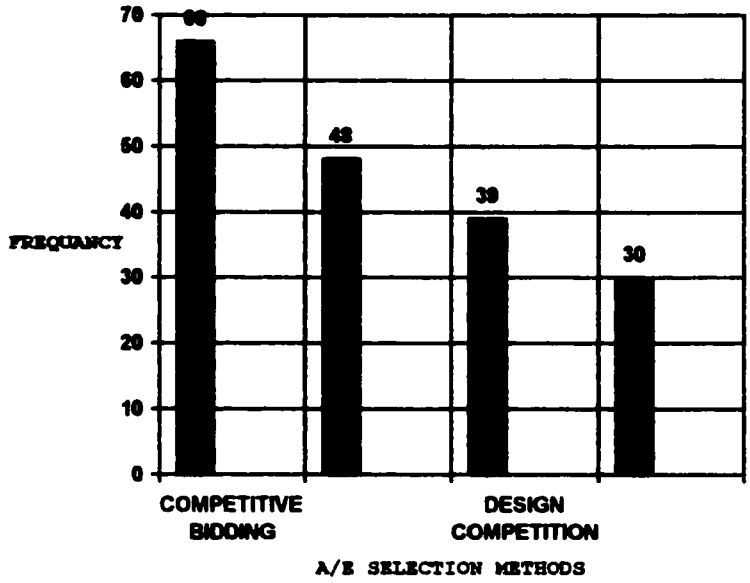
envelope and the price proposal is in the second envelope. The second envelope will be opened only if the first envelope "technical proposal" is selected. The second envelope "price proposal" is used for negotiation.

In Saudi Arabia, the selection methods used by the public sector are the competitive bidding, direct selection, and design competition method. Table 2-3 and figure 2-6 show the A/E selection methods as indicated by the public sector {6}. The competitive selection practice is the prevailing system within the public sector. Even-though procurement regulation states that the competitive bidding is the most suitable and fair for selecting A/E, but the direct selection method is also used.

**Table 2-3:** A/E Selection (As Indicated by Public sector)
**Source:** Al- Musallami 1992.

| A/E Selection Methods | Frequency % |
|---|---|
| Competitive bidding | 66 |
| Direct method | 48 |
| Design competition | 39 |
| Nomination | 30 |

FIGURE 2-6:A/E'S SELECTION ( AS INDICATED BY PUBLIC OWNERS )




## 2-3 Previous Studies

In general, many studies have been conducted on consulting and engineering practices. An examination of the literature currently available has revealed that A/E selection procedures have been developed to assist the public sector organizations in A/E pre-qualification and selection. However, in Saudi Arabia, while limited research has been conducted on the A/E practice, no specific and detailed studies have been done into A/E pre-qualification and selection. The A/E pre-qualification and selection procedures have been briefly discussed or mentioned by some previous construction studies only as subtitles to indicate the relevance and the importance of A/E pre-qualification and selection methods to the construction industry.

Jordan (1991) and Abolnour (1994) indicated that, when the design budget is allocated for a new project and the need for A/E services are confirmed, one of the first tasks for the public sector is selecting a suitable A/E from a long list of candidates. This results in the selection and engagement of the most qualified A/E, which establishes the project quality from the earliest stage. However, in recent times the A/E selection has become a commutative nationwide problem aggravating the situation in both public and private sectors.

When Al-Musallami (1992) conducted a study on the consultancy practice in Saudi Arabia, he had concluded, " the public clients are the major users of A/E design services". This is due to the fact that the project size and design complexity, demand for specialized services that are beyond the in-house design capabilities within the public sector, but offered by some expatriate and local A/Es in the private sector. The A/Es are selected mostly by the comparative method. Sixty six percent (66%) of owners use this method, which is considered the fairest to both owners and A/E firms.

AL-Subiae (1987) and Moore (1986) indicated that construction claims, disputes, owner's dissatisfactions, litigation, A/E design errors, conflicts and ambiguities between contract documents and drawings can be avoided only by the proper selection of well-qualified A/E. This is a clear indication of the desirability of selecting the best possible A/E, and subsequently of exploiting his proper expertise to the full.

Al-Shiha (1993) conducted research on the effect of faulty design and construction factors on the maintenance of facilities. One of his strongest conclusions is that A/E poor selection affects not only the design and construction stages of the projects. The poor selection of unqualified A/E, along with unqualified and inexperienced staff, faulty design services and poor working experience will surely form a major foundation for financial obstacles causing a gradual increase in the running or maintenance costs of buildings, and may shorten the effective life span of the facilities.

Since consultancy services are difficult to be specified, quantified and written, the idea of A/E selection based only on the competitive price is not totally desirable and not usually in the best interests of the public sectors, as was previously thought. Such practice destroys the A/E creativity. An A/E with a better and realistic proposal for the work will not be selected mainly because of high price. Furthermore, an A/E's technical and business abilities are only utilized with minimum application. The owners will not be getting what they are looking for in terms of the A/E attention to detail and likelihood of making the best recommendations and consequently the A/E will no longer represent the best interests of the owner. The overall result: "A/Es will become merchants, thinking only of competing and winning the project, and in the process sacrificing creativity and quality."

AL-Saleh (1980) indicated that government's officials and engineers are dissatisfied with the A/E selection process and criticized it. He believes that "the A/E selection should be based upon the professional qualifications necessary for the satisfactory performance of the services required by the government agencies/ministries".

William Moore (1986) indicated that compatibility, level of effort and pricing of the services are criteria that must be identified for selecting a qualified A/E firm, and seeking a successful and constructive client-consultant relationship. The identification of the A/E broad business and professional knowledge, good judgment, experience, and a clear understanding of A/E to the client's needs will lead to the successful selection based on highly applied qualifications, but opposing to price to be the controlling factor of the selection process.

Aitath (1988) in studying the bid awarding system in Saudi Arabia and through the survey of the construction parties, found that projects awarded only on the basis of the lowest bid had lower performance quality compared to those awarded on the basis of proper qualifications and competence. This assumption is always true when A/E selection is considered on the basis of the lowest fee without any consideration to the

related qualifications. The A/E selected on the basis of a low bid may lack the competence and required experience.

Cushman and Plamer (1980) indicated that an A/E selection is of great importance to the owner's satisfaction. It should not be done without comprehensive evaluation of an A/Es' qualifications by exploring the A/E ability to carry out the current, and proposed work without affecting performance adversely.

DuWayne Kasma (1987) indicated that an A/E skills and competence are essential factors for evaluating its abilities. Therefore, the high quality and success of professional services will depend on systematic A/E selection, considering the A/Es' competence and qualifications, not on the selection based on price competition. Selections based on low price competition often result in negative impacts on the quality of services. The inadequate cost, and the utilization of the A/E limited technical capability and creativity are commonly observed results of poor A/E selection, not based on proper evaluation of selection criteria. The amount of money saved in selection based on price competition is insignificant when compared to the increased construction and life cycle costs if an unqualified A/E is selected.

In the previous literature reviewed here, the selection processes were developed in an attempt to improve prequalification and selection procedures and provide a systematic approaches to help public sector organizations in selecting and engaging A/Es for professional services. Each procedure employs different evaluation trend in comparing the selection alternatives in terms of the related selection criteria. Although each procedure conducts the prequalification screening in different ways, but they all have one common objective: ***"shortlist the competing A/Es and select only capable A/Es having the proper qualifications"***. The arrival to a precise accomplishment depends on the quality of defining the specific criteria, quality of evaluation procedure and quality of understanding what the selected A/E ability is.

Kasma (1987) in his research " consultant selection" recommended a policy and procedure for the public sector in procuring and selecting A/Es for professional

engineering services. The proposed procedure was meant to be fair and acceptable by both owners and A/Es. The proposed method included the following steps "Soliciting qualifications of A/E firms, Receiving A/Es proposals, Selecting A/E firms to interview, Conducting interviews, Negotiating contract". He indicated also that " Technical Experience, Past Performance and Reputation, Staffing, Approach to Project, objectives of project, and Proximity" are criteria that must be evaluated in order to ensure the successful selection of qualified A/E for the proposed work.

Potter and Sanvido (1994, 1995) presented a model to help the public sector to select the most appropriate A/E for a proposed project. The proposed model allows the public sector to perform a consistent evaluating procedure to evaluate the A/E ability using a systematic, strong, and outstanding professional prequalification approach. It enables the public sector to objectively differentiate between the qualifications of the competing alternatives and then to select the A/E with the education, experience, and managerial ability to meet the requirements of project. The studies presented guidelines for using the Design and Build Prequalification Systems (DBPS) to help the public sector in prequalifying and selecting a design and build team which may include project management, design professional, and construction. Using an existing framework, the model was presented into six constraints, which included economic, political, technological, corporate policy, labor and personnel, and legal. The proper evaluation of these constraints would result in determining the potential team members that should be selected. The presented model was tested in the public sector for the prequalification and requesting proposals (RFP)

Changes in the local construction industry, caused the changes in the local market, increased the availability of specialized works, the number of A/Es and the competition. With these came the continuous problems associated with incompetence, cost cutting, poor quality work, poor A/E selection and other undesirable practices. To minimize the above problems and to ensure that the most qualified A/Es are selected in a fair and equitable manner, current A/E selection procedures vary from one to the other. Basically, they are financially oriented. Any method of selection should first

consider qualifications, experience, competency, and availability. For successful A/E prequalification, none of these considerations should be overlooked. However, the extreme difficulties in the prequalifying process, where the skills of the competing A/Es are compared with related multiple criteria, have minimized the successful applications of many selection procedures.

Therefore, the most highly recommended approach is to utilize and benefit from the multiple criteria decision-making process (MCDM). This approach will be flexible enough to accommodate as many related criteria as required by the public sector. It will ensure that the A/E selection procedure is carried out based on the A/E ability and qualifications. No compromise will be permitted as part of the selection method utilized {37.

In Saudia Arabia, Assaf and Jannadi (1995) in their research titled "a multi-criteria decision-making model for contractor prequalification selection", proposed a method for prequalification and selection of contractor in Saudi Arabia based on the MCDM. Their method utilizes the multi-criteria decision approach to help owners make critical decisions successfully. It considers all prequalification criteria that are important to the owners, and it compares the criteria as they relate to the owners' preference. Then, criterion weightings are entered in an evaluation matrix for evaluating and ranking for final selection. The proposed method is carried out as follows:

First, the criteria that are of importance to the selection process are all listed. The important criteria considered are experience, equipment resources, financial stability, manpower resources, current workload and quality performance. Then, how important each criterion is to the owner and the proposed work is determined. Each criterion is assigned a letter of the alphabet. When selecting between two criteria, the degree of importance of one criterion over another can be:

| | |
|---|---|
| Major | (3 points) |
| Medium | (2 points) |

Minor (1 points)

No preference (0 points)

For example, if experience (A) is decided to be of greater importance than manpower resources (D), then it receives a score of 3.Thus, the comparison between (A) and (D) in the criteria scoring matrix is recorded with an (A-3) notation. If experience (A) and quality performance (B) are equally important, then each shall receive zero and the notation (A/B) is recorded on the evaluation matrix.

Next, the total raw score of each criterion is established. The method proposed a total raw score of 8 for experience, 7 for quality performance, 5 for financial stability, 1 for equipment and manpower resources, and 2 for current workload. Then, the raw scores are adjusted to a scale of 1-10 with 10 assigned to the criterion with the highest raw score. So A, B, C, D, E, and F have adjusted scores of 10, 9, 6, 1, 1, and 3 respectively.

Once the criteria elements and their weightings have been established, they are entered into an evaluation matrix as shown in Figure 2-6. First, each criterion is ranked against each selection alternative. The 1-5 scoring scale is used as follows:

Excellent = 5

Very Good = 4

Good = 3

Fair = 2

Poor = 1

Then the rank of each selection alternative and the weight of each criterion are multiplied and the result is entered into the provided space. The score is totaled up for each selection alternatives and ranked for selection. The alternative having the highest total score is selected (Table 2-5).

**Table 2-4:** Determining weights for evaluation

| Criteria | | Raw Score | Assign Score |
|---|---|---|---|
| A | Experience | 8 | 10 |
| B | Quality performance | 7 | 9 |
| C | Financial stability | 5 | 6 |
| D | Manpower resources | 1 | 1 |
| E | Equipment resources | 1 | 1 |
| F | Current work load | 2 | 3 |

| | B | C | D | E | F |
|---|---|---|---|---|---|
| A | A/B | A-1 | A-3 | A-2 | A-2 |
| B | | B-1 | B-1 | B-3 | B-2 |
| C | | | C-3 | C-2 | C/F |
| D | | | | D-1 | F-1 |
| E | | | | | F-1 |

**Figure 2-7:** Comparison Matrix.

(3-major preference, 2-medium preference, 1-minor preference, 0-no preference)

| Criteria | Raw Score | Assign Score |
|---|---|---|
| Criteria A | | |
| Criteria B | | |
| Criteria C | | |
| Criteria D | | |
| Criteria E | | |
| Criteria F | | |

**Figure 2-8:** Paired Comparison

**Table 2- 5:** Evaluation Matrix

| A/Es | Weight | Criteria A | Criteria B | Criteria C | Criteria D | Criteria E | Criteria F | Total |
|---|---|---|---|---|---|---|---|---|
| A | | E | E | E | E | E | E | Rank |
| | | VG | VG | VG | VG | VG | VG | |
| | | G | G | G | G | G | G | |
| | | F | F | F | F | F | F | |
| | | P | P | P | P | P | P | |
| Sub-total | | | | | | | | |
| B | | E | E | E | E | E | E | Rank |
| | | VG | VG | VG | VG | VG | VG | |
| | | G | G | G | G | G | G | |
| | | F | F | F | F | F | F | |
| | | P | P | P | P | P | P | |
| Sub-total | | | | | | | | |
| C | | E | E | E | E | E | E | Rank |
| | | VG | VG | VG | VG | VG | VG | |
| | | G | G | G | G | G | G | |
| | | F | F | F | F | F | F | |
| | | P | P | P | P | P | P | |
| Sub-total | | | | | | | | |
| D | | E | E | E | E | E | E | Rank |
| | | VG | VG | VG | VG | VG | VG | |
| | | G | G | G | G | G | G | |
| | | F | F | F | F | F | F | |
| | | P | P | P | P | P | P | |
| Sub-total | | | | | | | | |
| E | | E | E | E | E | E | E | Rank |
| | | VG | VG | VG | VG | VG | VG | |
| | | G | G | G | G | G | G | |
| | | F | F | F | F | F | F | |
| | | P | P | P | P | P | P | |
| Sub-total | | | | | | | | |
| F | | E | E | E | E | E | E | Rank |
| | | VG | VG | VG | VG | VG | VG | |
| | | G | G | G | G | G | G | |
| | | F | F | F | F | F | F | |
| | | P | P | P | P | P | P | |
| Sub-total | | | | | | | | |

The Analytic Hierarchy Process (AHP) which was developed by the well-known mathematician Thomas L. Saaty is another powerful method found in current literature that was applied the use of the multiple criteria approach for alternative selection in the construction area.

Abdelrazig (1996) in his study titled "A Computerized AHP Model for Solving Bid / No-Bid Decision Problem" presented a structured methodology to help contractors in Saudi Arabia to make their bid/no bid decisions by using the AHP approach. The computer software program known as "Expert Choice" (V8) based on AHP and the "Bid / No Bid" decision was used to develop and solve the bid / no bid decision model. The model was then used in a real project to test its completeness and its ability to solve bid-no-bid decision problem.

Other studies have indicated the widespread use of the Analytic Hierarchy Process in the engineering and construction industry. Hanratty (1992) used the AHP to solve the chemical laboratory reactor selection by comparing the different reactor configurations.

Mitta (1993) used the Analytic Hierarchy Process (AHP) process to rank a set of five computer interfaces for an automated part recognition system. His study made the selection based on the usability and learnability characteristics.

Riza and Yvon (1988) proposed a method for project evaluation and selection. He used the Analytic Hierarchy Process instead of goal programming to set priorities and trade-off among objectives.

Mustafa (1991) used the Analytic Hierarchy Process process in the assessment of risk in constructing the Jamuna Multi-Purpose Bridge in Bangladesh.

In the military field, Woo Lee (1991) used the Analytic Hierarchy Process approach in his study titled "Static Valuation of Combat Force Potential by the Analytic Hierarchy Process (AHP)" as a powerful tool in establishing the relative value of military weapon systems. He concluded that the analytic hierarchy process AHP is the preferred approach for systematically accommodating the expertise of those people who

must be involved in the evaluation of a wide range of heterogeneous weapons. The main aim of his study was the determination of the weapon's quality performance.

# CHAPTER THREE
# THE CONSULTANT SELECTION CRITERIA

# 3 CHAPTER – THREE -THE CONSULTANT SELECTION CRITERIA

## 3-1 Introduction

Once the need for selecting outside help for professional services is confirmed, then the engagement " ***A/E selection***" for professional services needs to be objective. The public sector is faced with the task of determining the qualifications and skills of applicants, and making decisions as to which A/Es should be selected to submit technical proposals for the service needed {13}.

The success of the A/E selection procedure depends on the quality of the project's specific criteria. These criteria are defined specifically to guarantee the accomplishment of the selection process, the quality of evaluating these criteria to arrive at the best A/E selection, and the quality of understanding of the prospective A/E ability. The positive accomplishment of the selection procedure requires comprehensive evaluations of the A/Es' abilities. Evaluation includes comparison of the abilities of the alternatives / applicants in terms of their qualifications, skills and experience. Such an approach will expose the advantages and disadvantages of the candidates that will enlighten soliciting agency, thus enabling them to make a final selection.

First, the soliciting organization should define an approach "*Qualifications, Skills, and Experience*" that will not only control the selection process, but will also successfully judge suitability of the A/E appropriateness for the proposed project. Public sector organizations must clearly define a systematic approach represented by a set of specific criteria for screening A/Es' long list of A/Es before final selection takes place. However, it should be remembered that even though a given set of criteria represents the minimum selection requirements, it must be identified correctly and assigned carefully to assure objective selection that considers both qualifications and

the technical and business conditions of the project. The significant purpose of evaluating these criteria "using a pre-qualification process" is to establish the financial, technical, managerial capability and competence of each A/E to perform the proposed work. An investigation of the general reputation, financial integrity, demonstrated ability with respect to time frame and quality performance, and the scope of earlier projects gives some indication of what may be expected from the selected consultant firms {2}.

Literature and previous studies have been investigated to find out the most important criteria for A/E pre-qualification and selection. They have indicated that A/E selection is of great importance to the public sector and should not be done without complete evaluation of those criteria influencing and controlling the selection process {13}. Each of the identified criteria was found to have a certain level of importance to the owner and the project. They must be considered and each must be satisfied in order to arrive at a conclusive and successful A/E selection. The objective evaluation of these related criteria will eventually accomplish the overall objective of the selection process.

## 3-2 The Selection Criteria

The following criteria should be considered by the public sector in selecting A/E, no matter which selection method is used:

### 3-2-1 Current Work Load

When selection of an A/E becomes a necessity, then an important and logical question must be raised: Does the promoted "A/E" have adequate capacity to add a new project to his current work schedule? This is a simple question, but an important one that can be answered by requesting the A/E to submit data explaining his current

work schedule for analysis to establish the capability of adding new work to the current schedule.

No matter how large, experienced, and financially capable a consultant firm is, it will have a maximum capacity. This capacity should not be exceeded. Both available resources and the projects' conditions must be considered. This controls how many projects can be undertaken by the consulting firm.

This criterion will assess the A/E ability to manage and meet all of the needs of ongoing projects. Examining the information of A/E current and prospective workload provided, in terms of volume, timing, sequence, and priorities of projects will establish how the A/E will organize and manage staff and financial resources to accommodate the new work. The management must consider the additional resources required for the new projects {13, 29}.

The A/E resources such as staffing, office organization and financial resources should be evaluated when the number of projects are increased in addition to the projects in hand and the expected projects won in line with other clients. Depending on the size and complexity of the project, the management of the new project will definitely require substantial financial support due to the increased volume of work. Manpower reassignment or new recruitment will be considered. All of these will have an effect on the A/E capacity to handle further work.

### 3-2-2 Experience

This criterion is an assessment of an A/E firm to determine whether or not the A/E has the basic technical knowledge, experience, and understanding of the requirements to execute all tasks associated with the proposed project. The A/E experience is a major factor that should not be under-evaluated or overlooked by the soliciting organizations. It should also be remembered that an A/E firm may appear to be experienced, but not all experienced A/Es are applicable, and the A/E experience

may not be the desired experience and hence the advantage of this experienced consultant will not be utilized effectively.

The A/E previous experience in works similar to the proposed work's type, size, and complexity is an important criterion in establishing the A/E ability to meet all the requirements needed to carry out the proposed work. The soliciting organizations should define the experience required, and should not reject A/Es merely because of limited experience. The experience of new, large, and small A/E firms is to be judged in relation to the defined technical experience of project.

Jordon (1991) stated that the California Department of Transportation uses the A/E experience of completed works and qualifications and experience of key personnel to select the most qualified A/Es.

Potter and Sanvido (1994) considered technical experience as one of the important criteria in the design build pre-qualification system (DBPS) to prequalify and select a design build team.

Al-Shihah (1980) indicated that engaging unqualified A/E contributes to poor design and high facility maintenance cost. It is ranked number two (2) among sixty-seven (67) design and construction defects affecting maintenance. The severity index of this factor was found to be in the area of 79.43%.

### 3-2-3 Economic Constraint

Sufficient cash flow is important in the A/E business as it is in any other business activity. The financial position assessment of an A/E firm will provide an efficient tool to analyze and check the A/E's credit rating and debts, if any, and assure the owner of the good standing of A/E financial ability to meet the financial needs. The A/E engagements will be affected by an unstable financial position.

Fidic (1991) stated that financial resources are a critical factor which owners are positively advised to check. It establishes whether or not an A/E has a cash flow

difficulty or high debts and will ensure the A/E ability to secure and handle adequate resources needed to carry out the work to the owner's satisfaction "*the specified quality, time, and cost.*"

### 3-2-4 Quality Control

High quality work results in owner satisfaction. Fidic (1991) has indicated that an A/E understanding of the needs of the owner can be evaluated through a proposed approach for quality assurance and quality control. The quality of the work performed by an A/E, in most projects, is one of the most important ways of measuring an A/E performance. The A/E should implement the QA/QC in the design stage to minimize later defects.

Al-Shihah (1980) determined that the A/E lack of quality assurance and control is among the defect factors that increase the cost of operation and maintenance. This factor was ranked forty-nine (49) among the sixty-seven design and construction defects affecting maintenance. The severity index of this factor is 64.76%.

### 3-2-5 Experience in Geographic Location

The A/E experience in the specific geographic location is also considered one of the most important criteria in the selection process. This criterion is an assessment of the A/E understanding and familiarity with local construction conditions, laws, labor law, building codes, whether, environmental conditions, and other requirements that will have a direct impact on the project's activities.

AL-Subiae (1987) indicated that lack of familiarity with the local conditions and environment is one of the major factors accounting for delays in the completion of construction project.

Cushman and Plamer (1980) indicate that dealing with the local government's processes requires the A/E to have adequate experience in the local construction industry.

Al-Shihah (1980) indicates that A/E should be aware of all local conditions that will have an impact on design and maintenance phases. This factor was ranked forty (40) among the sixty-seven design and construction defects affecting maintenance. The severity index of this factor is 67.38%.

### 3-2-6 Firm Capacity

This criterion is an assessment of the A/E ability to complete the work. The capacity of the A/E in terms of technical competence, managerial ability, and "staff and financial" resources should be checked to establish whether or not the A/E is capable of handling the proposed work in addition to his current commitments. The public sector should check that the A/E has sufficient "staff and financial" resources to complete the work.

Cushman and Plamer (1980) indicated that larger A/E firms have more available resources than small firms, but this will not establish the appropriateness of the A/E for the proposed project. The proposed project's type and size should be considered. This will assure the owner of the A/E capacity.

### 3-2-7 Firm Organization

The organization of the firm is also considered one of the important criteria which helps determine the ability of the A/E to handle the proposed project. It specifically pertains to the arrangement of the A/E resources in such a way that could enable him to carry out information / instruction and accomplish the work by making

decisions quickly, accurately and effectively. The A/E organization determines the flow of information and the decision-making process among the firm's different levels of personnel and with the clients. The analysis of this criterion is important to the selection process in order to ensure that the A/E organization will be effective and will accomplish the coordination that will improve communication between the public sector and the A/E.

Adrian (1976) indicated that within an A/E, poor communication accounts for poor performance.

Al- Musallami (1992), and Abolnour (1994) determined that A/E-public sector relationships are affected by the poor organization of the A/E, and that 30% of the public sector had experienced communication problems. As the A/E firms recruit their professional A/Es from different countries, the professional with different engineering practices and languages will have communication difficulties within the same firm and with other firms.

### 3-2-8 Staff Availability and Qualifications

This criterion is an assessment of the A/E ability in terms of the availability and qualifications of manpower resources. It is one of the most important factors that play major roles in controlling the selection process to establish whether or not an A/E is qualified enough to be selected to submit a technical proposal. This criterion plays a major part in evaluating every selection criteria, and in promoting the A/E experience to the public sector.

Al-Shihah (1980) indicates that the training of an A/E staff with the latest construction technology "methods, and materials" will have an impact on the building design quality. This factor was ranked nineteen (19) among the sixty-seven design and construction defects affecting maintenance. The severity index of this factor is 79.76%.

### 3-2-9 Head Office Location

The location of the head office of A/E is very important for the project performance. A large distance between the main office and site of the project will have an effect on the communication and project operation in general. The A/E "technical or financial" supports, the decision-making authority, and the information flow between site and main office is considered one of the important criteria in evaluating the A/E performance.

In addition to administrative supports and resolving major technical conflicts, the site engineer requests support from the head office in technical issues which may include "evaluation of design changes, contract modifications, negotiations or approval of change orders".

Potter and Sanvido (1994) considered location of head office as one of the criteria in the design-build pre-qualification system (DBPS) to prequalify and select a design-build team for the project.

### 3-2-10 Project Management Capabilities

This criterion is an assessment of the A/E managerial ability. The availability of adequate and experienced management staff is considered an important criterion that affects the A/E overall performance. Management staff includes the A/E key personnel and professional staff who have the managerial skills that match with the size and type of the proposed project. They must be capable of planning, scheduling, and managing the firm's resources to accomplish the work according to professional standards.

Fidic (1991) stated that the public sector could assess the A/E managerial ability by checking his past project achievements and his ability to communicate.

### 3-2-11 Reference and Past Performance

This is an important criterion to help evaluate the recent performance, reputation, and the quality of the A/E completed projects with respect to the stipulated time and allotted budget. The references of an A/E can be checked through visiting completed projects where the A/E worked designed or supervised. This will give the client a clear picture of the A/E achievement concerning quality of performance, practical years of experience in the type and size of projects, and his ability to interact effectively with the contractors and clients. The A/E honesty, trust worthiness, fair dealing, integrity, and behavior are important criteria for evaluating the performance.

Jordan (1991) indicated that the California Transportation Department uses the nature and quality of the completed work as successful criteria for selecting the most qualified A/E.

## 3-3 The Pre-qualification in Saudi Arabia

The pre-qualification process is defined as the screening of consultants (A/Es) by owners or their representatives against predetermined set of selection criteria. Evaluating qualifications against these criteria will ensure a successful selection process and the selection of the most qualified A/E.

Among the Saudi public sector organizations, the selection of A/E is mainly done by selecting A/E from a predetermined list of A/E. This list differs from one agency to another and is mainly based upon a predetermined set of prequalification

criteria. Successful or poor selection depends on quality evaluation, quality criteria, and how these criteria are related to the project in hand.

Three prequalification questionnaire samples are investigated below to identify the most common and important criteria used by the public sector during the selection process.

These three samples are as follows:

### 3-3-1 First Pre-qualification Questionnaire

This questionnaire is used by the General Directory of Military Works (GDMW) responsible for the engineering work within the Saudi Armed Forces. The GDMW is one of the Ministry of the Defense and Aviation's (MODA) engineering departments. The questionnaire (Appendix-C) is represented by sixteen items as:

- Items Numbered (1) to (6) give general information about the A/E firm such as:

  Name of the A/E
  Location
  Address
  Owner(s) Name
  Type of ownership
  Previous Name (if any)
  Branches and addresses
  Telephone, Fax Numbers, and Post Box.

- Items (7) ,(8), (9), and (12) request information on the staff such as:

  Key Personnel.
  Experience.
  Position.
  Engineers (all discipline).

Total staff within the past five years.

- Item numbered (10) requests the identification of the A/E affiliated A/E Firms.
- Item numbered (11) requests the identification of the A/E field of specialization.
- Item numbered (13) requests listing of works or projects currently undertaken by the A/E.
- Item numbered (14) requests listing projects currently undertaking by the A/E in a joint-venture with others.
- Item numbered (15) requests listing of the completed projects by the A/E within the past ten years.
- Item numbered (16) requests A/E to identify the field or type of services for prequalification.

The information from the above prequalification has clarified that the main criteria used by the Ministry of Defense and Aviation –General Directory of Military Works (MODA- GDMW) are as follows:

1. Experience of Completed Works.
2. Experience of Current Works.
3. Key Personnel and their Qualifications
4. Field of Specialization.

### 3-3-2 Second Pre-qualification Questionnaire

This questionnaire is used by the World Islamic Bank to prequalify the consulting firms for projects within the Islamic countries. The questionnaire (Appendix-C) represented many parts. However, for this study we investigated only parts (A, B and C) with items related to the general, engineering and construction works.

The items included in **Part A – Firm Description** are as follows:

- The items numbered (1) to (10) of Part A contain information about the A/E firm such as:

  Name of the A/E, and year established.
  Address of home office, and telephones...
  Type of organization.
  Project description.
  General information about the firm.
  A/E partners, directors, and key personnel.
  A/E ownership, and nationality.
  A/E membership of professional associations.

- The item numbered (11) of Part A contains information about the firms affiliated with the A/E.
- The item numbered (12) of Part A contains information about the A/E branches.
- The items numbered (13, and 14) of Part A contain information about the A/E professional personnel and language capability.
- The item numbered (15) of Part A contains information about the A/E annual volume of gross fees.
- The item numbered (16) of Part A contains information about the A/E bank and other financial references.

The items included in **Part B – Firm capability** as follows:

- The item numbered (17) of Part B contains services provided by the A/E firm.
- The item numbered (18) of Part B requires A/E to identify the field of specialization.

The items included in **Part C – Firm Experience** as follows:

- The items numbered (19, and 20) of Part C request A/E firm to list the countries in which the firm is working now or has completed projects or services within the past five years.

The above prequalification indicates that the main criteria used by the Islamic Bank are as follows:

1. Head Office Location and Branches.
2. Experience of Completed Works.
3. Experience of Current Works
4. Experience in Geographic Area.
5. Firm Organization.
6. References
7. Key Personnel, Qualifications, and Capability.
8. Sector of Specialization.
9. The Firm's Capacity.
10. Financial Background and References.

### 3-3-3 Third Pre-qualification Questionnaire

In the United States of America, the Forms SF254, and SF255 (Appendix-C) are two important questionnaires that act as standard guides that allow the consultants to define the firm's capabilities, personnel's expertise, background, and experience relative to the federal projects. Evaluation of the completed SF form is done by the federal agency to emphasize the A/E capability {41}. The SF 254 and SF 255 questionnaire forms are similar. The two forms indicate the common and important criteria that must be considered in the engagement of an A/E for professional services. These criteria are as follows:

1. Head Office Location and Branches.
2. Experience of Completed Works.
3. Experience of Current Works
4. Firm Organization.
5. References
6. Key Personnel and Qualifications.
7. Sector of Specialization.
8. Firm's Capacity.
9. Quality Performance.
10. Service Fee.

Based on the literature review and the examination of the above three questionnaire samples, it is noticed that the common criteria used by the public sector in determining the A/E capability are as follows:

1. **Experience of Completed Works.**
2. **Experience of Current Works.**
3. **References and Past Performance.**
4. **Key Personnel and their Qualifications.**
5. **Management Capability.**
6. **Field of Specialization.**
7. **Firm's Capacity.**
8. **Financial References.**
9. **Firm Organization.**

In addition, other observed criteria are to be evaluated depending on the specific requirement of the project.

# CHAPTER FOUR
# MULTIPLE CRITERIA DECISION-MAKING

# 4 CHAPTER-FOUR- MULTIPLE CRITERIA DECISION-MAKING (MCDM)

## 4-1 Introduction

Multiple Criteria Decision-Making (MCDM) approaches are efficient tools for making critical decisions in many fields. They are utilized when decision-makers are faced with difficulties because of more than one objective or criteria that have to be satisfied in order to arrive at a successful and final selection from the available alternatives {21}. The MCDM approach involves structuring the problem, evaluation of criteria and alternatives, prioritization, and synthesis. In the MCDM, the first task is to obtain a set of objectives or requirements for the achievement of the overall objective. In this study, A/E selection will be the overall objective and the applicable criteria considered for the A/E selection are listed in section (3-2). Identification of these objectives or requirements constitutes an important component of the multiple criteria decision- making {33}. The procedure will carry out comprehensive evaluations of alternatives and objectives for the purpose of selecting the best alternative. The decision- makers will have to determine the criteria that are important to the selection procedure and each criterion is assigned a weight according to relative importance. After listing all the applicable criteria and determining their degree of importance, a list of alternatives would be proposed and subjected to rigorous evaluation considering all of the established criteria. Alternatives that satisfy the predetermined important criteria will be ranked accordingly, and the alternative that scores the highest should be selected as the best solution to the selection's overall objective.

Since the A/E selection is one of the most repeated and complex problems facing public sector organization, it's success requires consideration and comparison of many criteria for multiple alternative selection. Currently, selecting A/Es from the long

list available is carried out by the application of human judgement based on the committee members' experience and intuitions. Inconsistencies and the lack of flexibility in evaluating selection criteria limit this method. Therefore it will be extremely appropriate to utilize one of the Multi-Criteria Decision-Making (MCDM) approaches to solve A/E selection procedure difficulties, to rank the alternatives, and to come up with the best alternative for final selection.

The Analytic Hierarchy Process (**AHP**) is one of the multi-criteria approaches. AHP is a comprehensive, powerful and flexible multi-criterion decision tool that can be used for prioritizing alternatives associated with a system and for determining trade-offs among them. Although there has been a wide application of AHP in many fields, no literature was found to report the use of AHP as a decision-making tool in the process of A/E selection. Thus, AHP will be used in this study to overcome the inconsistency associated with the selection problem whose decision criteria are expressed in subjective measures. This consistency is exactly what we need during any A/E selection procedure.

## 4-2 The Analytic Hierarchy Process (AHP)

In our complex world system, we are forced to deal with more problems than we have the resources to handle. To deal with such complex and unstructured problems, we need to order our priorities, to agree that one objective outweighs another, and to make trade-offs to serve the greatest common interest or overall objective. But with complex problems where a wide margin of error is possible in making the tradeoffs, it is always difficult to agree on which objective outweighs the other and to reach the best solution. The above difficulty proves that we need a framework, so we can view the problems in a complex but organized framework that allows for interaction and interdependence among factors and yet still enables us to think about them in a simple way. The Analytic Hierarchy Process (**AHP**) provides this kind of framework {37}.

The Analytic Hierarchy Process (**AHP**) is a multi-criterion decision-making approach developed by Thomas Saaty in 1971. AHP is a powerful decision-aiding tool that can deal with the intuitive, the rational, and the irrational when making decisions considering the suitability of large number of selection factors and alternatives. AHP is an appropriate MCDM approach for conducting both deductive and inductive evaluation that allows the consideration of several criteria and alternatives at a time, along with the benefit of a feedback mechanism and numerical tradeoffs. It is becoming a more popular and practical tool than the traditional multi-attribute utility theory, because it enables the decision-makers to resolve complex problems by simplifying and expediting the natural decision making processes. Basically AHP is a method designed to examine complex issues by breaking down the complex, unstructured problem into its constituent elements; constructing a hierarchy with the ultimate goal at the top level; selecting criteria or objectives that must be satisfied at the next level; listing alternatives at the lowest level; assigning numerical values to subjective judgements on the relative importance of each element; and synthesizing the judgments to determine which alternatives have the highest priority.

The evaluation is conducted by using the developed pairwise comparison judgements that result in the numeric representation of each comparison by a point estimate. The calculation of priorities (or prioritization) is carried out using the Eigenvector method, and the synthesis is done using the linear additive value function.

The AHP provides an effective structure for group decision making by imposing a discipline on the group's thought processes. In addition, the consensual nature of group decision making improves the consistency of the judgments and enhances the reliability of the AHP as a decision-making tool. The AHP combines the deductive and system approaches into one integrated, logical framework. The deductive approach focuses on the parts whereas the system approach concentrates on the working of the whole {19, 33, 35,38,and 34}.

### 4-2-1 Advantages of AHP

The present complex world has forced our human minds to cope with much complicated problems than in the past when life's operational systems were not so complex. To deal with these complex problems, we must get away as much as possible from complicated manners and methods anticipate the solution of complex problems. Unlike many traditional decision-making methods used to deal with these complex problems, the proposed process should not require a constant specialized expertise to layout the appropriate steps leading to the required solutions {36}. The methodology also should has the following characteristics:

- Be simple to perform.
- Be adaptable to both individual and groups.
- Be natural to our intuition and general thinking
- Encourage compromise and consensus building.
- Not require inordinate specialization to master and communicate.
- Be easy to review.

AHP is the methodology which, if carefully conducted, will successfully satisfy the above objectives, and will have the following usage advantages:

1. AHP is a flexible model that allows individuals or groups to shape ideas and define problems by making their own assumptions and deriving the desired solution from them.
2. It is a practical way to understand complex problems by breaking them down into their constituent elements and measuring the intangible qualities of those elements quantitatively to determine their priority impact.
3. It offers a new way to integrate hard data with subjective judgements about intangible factors.

4. It consists of a new way to the incorporate judgments of several players and resolve conflict among them.

5. It utilizes a technique complementing other ones (benefit/cost, priority, risk minimization) for selecting projects or activities.

6. It provides a framework for group participation in decision making.

7. It enables decision-makers to test the sensitivity of the problem solution, or outcome, to changes in data.

8. It is a process for identifying, understanding and assessing the interactions of a system as a whole.

9. It is a practical way to deal with different kinds of functional relations in a complex network.

10. It provides a communication tool for monitoring and guiding organizational performance toward a dynamic set of goals.

11. It has the advantage of being widely used in many countries.

Figure 4-1 summarizes the advantages of using the AHP as a practical tool for problem solving and decision-making.

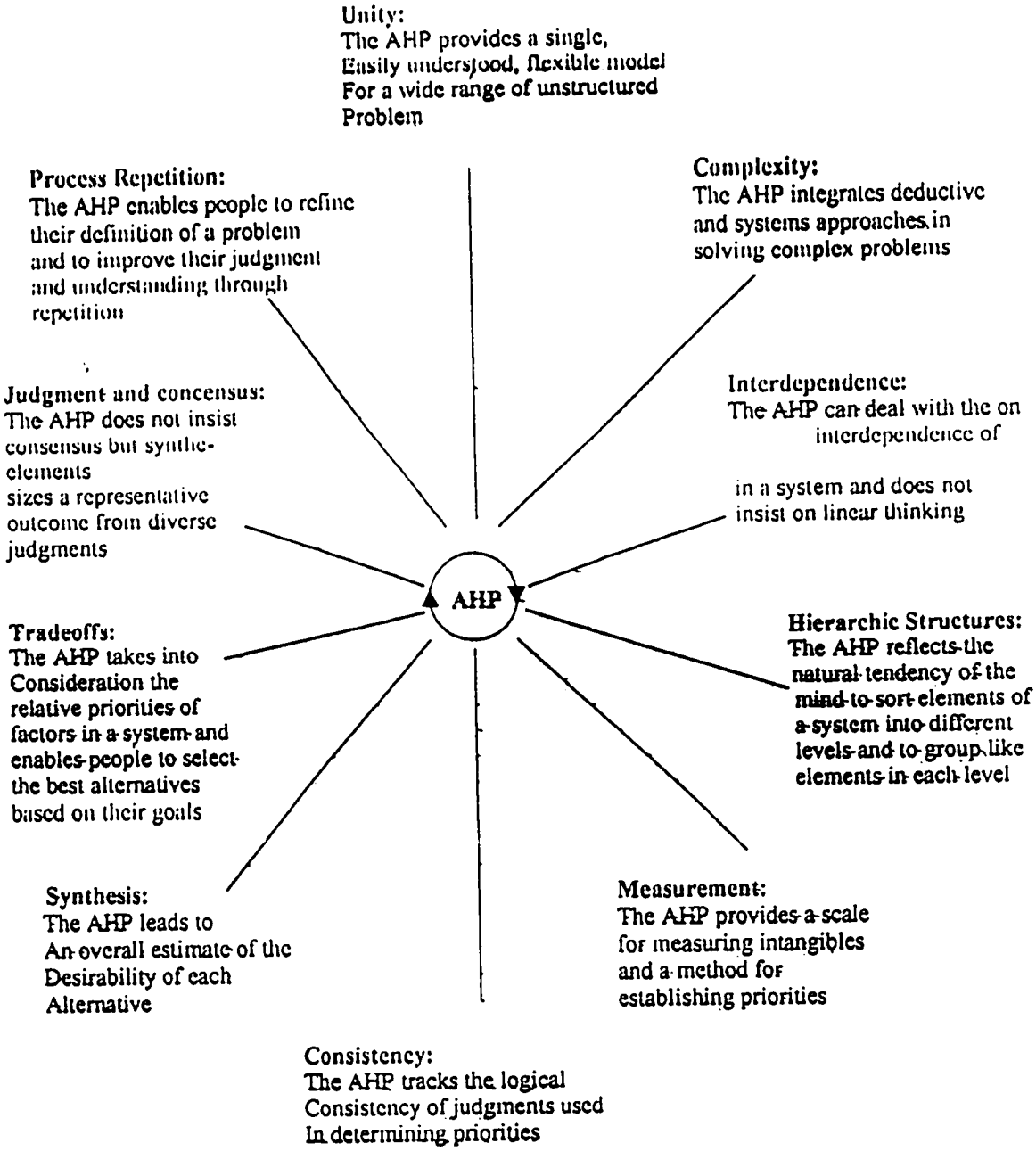



**Figure 4-1** Summary of Advantages of the Analytical Hierarchy Process

Generally, the Analytic Hierarchy Process (AHP) is a systematic approach for solving the difficulties of the decision making process by conducting the following steps {33}:

**Step 1:** Construct a decision hierarchy by breaking down the decision problem into a hierarchy of its elements.

**Step 2:** Collect input by a pairwise comparison of decision elements.

**Step 3:** Determine whether the input data satisfy a consistency test; if not, redo the pairwise comparisons.

**Step 4:** Calculate the relative weights of the decision elements.

**Step 5:** Aggregate the relative weight to obtain scores and hence rankings for the decision alternatives.

### 4-2-2 Structuring the Hierarchy

The first step in the Analytic Hierarchy Process (AHP) is constructing the hierarchy of the decision problem. There is no certain rule that can be followed for constructing a hierarchy. The main principle is brainstorming the complex problem, listing all of the important ideas, factors and alternatives, and then arranging them in a hierarchy that will enable the comparison of the elements of a lower levels with some or all elements in the next higher level. It is a creative way of exploiting human mind's ability to simplify a problem by breaking it down into the constituent elements that include the overall goal, the criteria and the decision alternatives. Following this process large amount of information can be integrated into the structure of the problem to form a more complete picture of the whole system. Figure (4-2) illustrates such a hierarchy.

At the top level of the hierarchy lies the chief overall objective of the problem, such as the objective of making the best decision or selecting the best alternative. There is no limit to the number of the levels in a hierarchy. However, the number of levels normally depends on the complexity of the decision problem or how much knowledge about the problem is available and usable, and mostly on the degree of detail required by decision-makers to solve the problem.

The lower levels of the hierarchy contain attributes or objectives that influence the decision and will contribute to the achievement of the overall objective. Details of the attributes increase at the lower levels of the hierarchy.

The last level of the hierarchy (K) contains decision alternatives. These alternatives contribute to the achievement of the criteria in a special way {34, 35,36}. This provides a standard form as shown in figure (4-2).

The completed hierarchy can be modified as needed to accommodate new and important elements that were not included during the development of the hierarchy. The uses of computer programs based on AHP are constructed with this flexibility in mind {35}.

The overall depth of detail of the hierarchy depends on the person's experience and familiarity with the subject, which will determine what to include and where to include it. When constructing hierarchies one must include enough relative detail: {34}

- To represent the problem as thoroughly as possible, but not so thoroughly as to lose sensitivity to change in the elements.
- To consider the environment surrounding the problem.
- To identify the issues or attributes that contribute to the solution.
- To identify the participants associated with the problem.

# The Analytic Hierarchy Process (AHP)

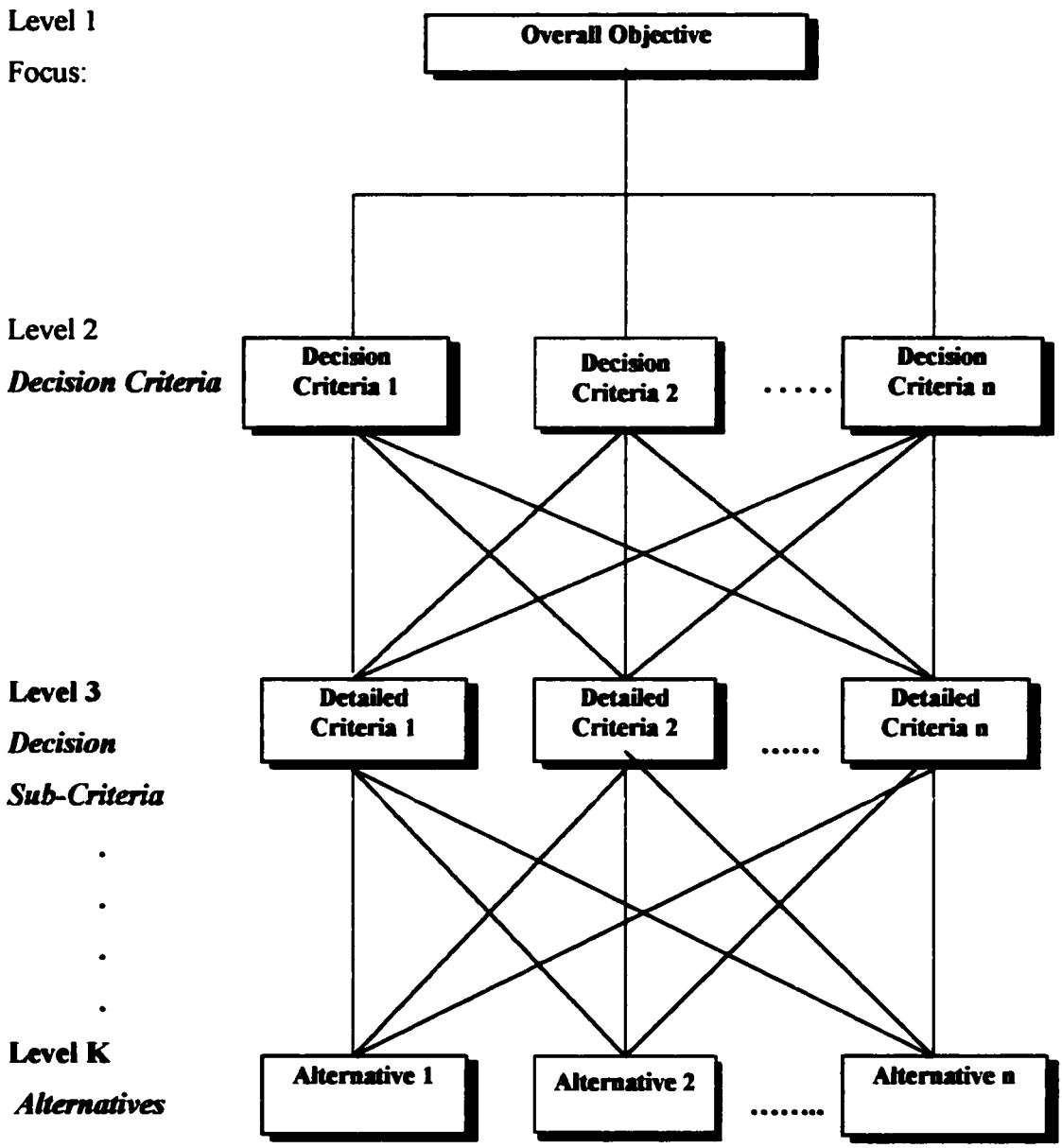



**Figure 4-2:** Standard Hierarchical Structure (Saaty1996).

### 4-2-3 Pairwise Comparison.

The next step is to establish the priorities for elements (criteria and alternatives) presented in the hierarchy. The AHP uses the pairwise comparison to do this. The first step is to make pairwise comparison. It is to compare the elements in pairs against a given criterion. The matrix is used for pairwise comparisons. The matrix is a simple, well-established tool that offers a framework for testing consistency, obtaining additional information through making all possible comparisons, and analyzing the sensitivity of overall priorities to changes in judgment {35}.

The priority entered in the matrix indicates how much more importance one attribute has over another. The nodes in the hierarchy represent alternatives to be prioritized, and the lines reflect the relationship between the alternatives of two levels. Each relationship is weighted according to the strength of influence that an alternative at the same level K exerts on alternative at level K-1, where K = 1, 2,3. . ...N.

In a complete system hierarchy, every element in the lower level affects every element in the upper level. But a hierarchy does not need to be complete. That is, an element in a given level does not have to function as an attribute (or criterion) for all the elements in the level below. An element in the higher level is said to be the parent element for these in the lower level since it contributes to or affects it. The elements in the lower level are then compared to each other based on their effect on the governing element.

The element that appears in the left-hand column of the matrix is always compared with an element appearing in the top row, and the value is given to the element in the column as it is compared with the element in the row. If element A dominates element B, then the integer is entered in row B column A. But, if element B dominates element A then the reverse occurs. For n elements there are n (n-1)/2 judgments required to develop the required matrix {35}.

The pairwise comparison process should be performed for each level in the hierarchy with respect to the level just above. This process can proceed from the top and go downward (evaluating the importance of the criteria and then the preference for the alternatives) – or from the bottom upward (evaluating the preference of the alternatives with respect to each criterion before evaluating the importance of the criteria). Unless the decision-maker is familiar with alternatives and the tradeoffs that affect them, it is usually best to proceed from the bottom up. By doing this, he/she gains insights into the tradeoffs involved and will be in a better position to evaluate the relative importance of the criteria.

The degree of importance (relative preference) is measured on an integer-valued 1-9 scale for two attributes. This scale has been validated for effectiveness, not only in many applications by a number of people, but also through theoretical comparisons with a large number of other scales {33,35}. When comparing alternatives, the term preference is appropriate, and the term importance is appropriate when comparing one criterion with another. Table 2-6 will be used to express these judgements as integers.

The final solution results in the assignment of weights to the alternatives located at the lowest hierarchical level (level K).

This represents an (n x n) comparison matrix rating based on preference. The preference measures are placed in matrix A as in the following form:

$$A = \begin{matrix} 1 & a_{12} & \dots & a_{1n} \\ 1/a_{12} & 1 & \dots & a_{2n} \\ \vdots & \vdots & \dots & \dots \\ 1/a_{1n} & 1/a_{2n} & \dots & 1 \end{matrix}$$

Each $a_{ij}$ entry of A reflects the factor by which alternative i dominates alternative j as follows:

1. $a_{ij} = 1/a_{ij}$, for $a_{ij} \neq 0$

2. $a_{ij} = 1$, for $i = j$ and $i, j = 1, 2, \ldots\ldots, n$.

Thus A is a reciprocal matrix.

The preference between two attributes is measured as equally preferred, weakly preferred, strongly preferred, or absolutely preferred, which would be translated into pair wise weights of 1,3, 5, 7 and 9, respectively, with 2, 4, 6 and 8 as intermediate values (Table 4-1).

**TABLE 4-1: Scale of Relative Importance According to Saaty (1980 )**

| Intensity of Importance | Definition | Explanation |
|---|---|---|
| 1 | Equal importance | Two activities contribute equally to the objective |
| 2 | Weak importance of one over another | Experienced and judgment slightly favor one activity over another |
| 5 | Essential or strong importance | Experience and judgment strongly favor one activity over another |
| 7 | Demonstration importance | An activity is strongly favored and its dominance demonstrated in practice |
| 9 | Absolute importance | The evidence favoring one activity over another is of the highest possible order of affirmation |
| 2, 4, 6, 8 | Intermediate values between the two adjacent judgments | When compromise is needed |
| Reciprocal of above non zero | If activity i has one of the above non zero numbers assigned to it when compared with activity *j*, then *j* has the reciprocal value when compared with *I* | |

### 4-2-4 The Synthesis for Overall Priorities Ranking

This part of **AHP** deals with the calculation of the priorities of each element through the hierarchy. The calculation leads to the overall result and the ranking of the elements. The synthesis proceeds in the three following steps:

- Sum the value of each column of pairwise comparison matrix.
- Divide each entry in the pairwise comparison matrix by its column total. This will produce the normalized pairwise comparison matrix.
- Then, determine the average of each row of the normalized matrix by adding the value in each row of the normalized matrix and dividing by the number of entries in each row. This provides the relative priorities of the elements being compared (35).

Further, the AHP uses the synthesis to develop an overall priority for ranking. The relative weights of various levels obtained are aggregated to produce a vector of composite weights which will serve as a ranking of the decision alternatives in achieving the most general objective of the problem. The composite relative weight vector of elements at Kth level with respect to that of the first level may be computed by:

$$C(I,K) = \prod_{I=2}^{k} B_i$$

Where:

C ( I , K) is the vector of composite weights of elements level k with respect to the element on level 1,

$B_i$ is the $n_{i-1}$ by $n_i$ matrix rows consisting of estimating W vectors.

$n_i$ represents the number of elements at level i.

Repeating the aggregation process yields relative weights of elements that are at the lowest level of the hierarchy with respect to the decision at the first level.

### 4-2-5 Consistency

Depending on the decision needed, the consistency is a useful way to test the consistency of the decision-maker's judgement in providing his judgements to the comparison matrix. However, it is very difficult to achieve perfect consistency. Analytic Hierarchy Process is useful to check the judgments provided in each hierarchy.

**W** (weighted sum victor), **CI** (consistency index), **CR** (consistency ratio), and **RI** (ratio index) are used for checking the consistency.

Assuming perfect A matrix, w is determined from the following equations:

$$\mathbf{A.w} = \lambda max\ \mathbf{w} \qquad (1)$$

Where A is the observed matrix of pair wise comparison, $\lambda max$ is the principal eigenvalue of A; **w** is its right eigenvector. In the above equation, the closer the $\lambda max$ is to n, the more consistent are the observed values of A, and hence the algebraic difference between $\lambda max$ and n is a measure of consistency {33}.

The consistency index is calculated as:

$$\mathbf{C.I} = (\lambda \mathbf{max} - \mathbf{n}) / (\mathbf{n} - \mathbf{1}) \qquad (2)$$

Where is n: matrix size, and $\lambda$ is the Eigenvalue

And for consistency ratio (CR) as:

$$\mathbf{CR} = (\mathbf{CI} / \mathbf{RCI}) * \mathbf{100} \qquad (3)$$

Where **RCI** is the average index randomly obtained from table 4-2 {33}.

A CR value of 10% or less is acceptable. But any CR value of more than 10% is not acceptable and the judgements in A matrix table should be reconsidered to resolve inconsistency judgements provided in pair wise comparison (35).

An approximation to the eigenvalue can be calculated by multiplying the total of each column in a judgement matrix by its corresponding vector of weights. The approximation is exact when the exact vector of priorities is used.

The consistency index of the entire hierarchy is obtained by multiplying the Consistency Index of each matrix by the priority of the criterion used for the comparisons, and all such quantities.

To check the consistency of the entire hierarchy, compare the Consistency Index of the hierarchy with its counterpart when the consistency indices of all matrices are replaced by average random judgment consistency indices for matrices of the same size (Table 4-3). The CR should not exceed 10%. If it is more than 10%, then the quality of the judgments should be improved, perhaps by revising the manner in which the questions are asked in making the pairwise comparisons. If this fails to improve consistency, then it is likely that the problem should be more accurately structured, that is, grouping similar elements under more meaningful criteria. A return to priority setting would be required, although only the problematic parts of the hierarchy may need revision (33,35).

**TABLE 4-2: RCI Values for Different Values of Number**

| Size of Matrix | Random Consistency | Size of Matrix | Random Consistency |
|---|---|---|---|
| 1 | 0 | 6 | 1.24 |
| 2 | 0 | 7 | 1.32 |
| 3 | 0.58 | 8 | 1.41 |
| 4 | 0.9 | 9 | 1.45 |
| 5 | 1.12 | 10 | 1.49 |
| | | | |

### 4-2-6 Making Group Decisions

As stated by the well known mathemetian Saaty:

"The AHP can be used successfully with a group. In fact, brainstorming and sharing ideas and insights often leads to a more complete representation and understanding of the issues than would be possible for a single decision-maker. But group sessions can also pose special problems.

When the analytic hierarchy process is used in a group session, the group members structure the problem, provide the judgments, debate the judgments, and make a case for their values until consensus or compromise is reached. In an ideal situation, the group is small and the participants well informed, highly motivated, and in agreement on the basic question being addressed. They are also willing to participate fully in a rigorous, structured process whose outcome will partly determine their future activities, no matter what differences of opinion still surround the results of the process. Again ideally, the group is patient enough to reconsider the subject so that, through iteration, the remaining differences of opinion are debated and an agreement is reached or at least the range of differences is narrowed.

But such a scenario is the exception. Often the participants are unequal in their expertise, influence, and perspective, and cooperation may take some coaxing by the leader. Patience on the part of the leader and the group is highly desirable; an unhurried, structured group discussion can yield a more satisfactory outcome than one achieved quickly and with little debate.

#### *4-2-6-1 Preliminary Steps*

First make sure that the participants are comfortable and well provided with writing materials, refreshments, adequate lighting, and so on. If the AHP is being used for the first time, explain how it works and illustrate it with simple applications. Large flip charts are convenient for this purpose. Allow for a question-and-answer period.

It may be helpful to have two discussion leaders with one or two assistants. A group session that lasts for two days, typical for planning, is quite taxing, and much of the pressure on either leader is reduced by having the other carry on when necessary. A computer terminal makes it possible to obtain answers immediately and to test the consequences of judgments with respect to sensitivity and consistency.

A good way to begin the session is by brainstorming the overall focus of the problem or plan. Several suggestions may be made, from which one is selected as most representative of the current overall concern. The important thing is to define the objective of the discussion clearly at the very beginning.

#### *4-2-6-2 Constructing the Hierarchy*

With the focus determined, the group defines the issues to be examined and constructs the hierarchy as richly as possible to cover the issues. The discussion should be relaxed and unhurried. The leader reminds the group that the purpose of the meeting is to construct the hierarchy and, through discussion, debate, and the use of pragmatic

imagination, to make pairwise comparisons from which priorities are set for the elements at the lowest level of the hierarchy. Overhead transparencies may be used to record entries in the hierarchy and matrices. After the hierarchy is completed, it should be drawn, typed, and distributed to all the participants. Before proceeding to the judgments, revisions are made and the hierarchy is retyped and redistributed. Such work can also be done jointly on computers.

Breaking down a complex issue into different levels is particularly useful for a group with widely varying perspectives. Each member can present his or her own concerns and definitions, no matter what the level may be. Then the group is assisted in identifying the overall structure of the issue. In this way agreement can be reached on the higher-order and low-order aspects of the issue through a clustering and ordering of all the concerns that members have expressed.

The group then agrees on how it will proceed to enter judgments. The whole group might start at the top level and then progress to lower ones. It may delegate to subgroups the responsibility of considering, subdividing further, or setting priorities on a particular level. Or it may choose a combination of these alternatives.

#### *4-2-6-3 Setting Priorities and Synthesizing*

Group priority setting is by nature interactive and noisy and involves bargaining and persuasion. This lively interaction need not be perfectly orchestrated—the participants may feel regimented and intimidated. Those who have no patience for the process should be allowed simply to observe or, if they wish, to leave the room and return when the process is completed. A leader should also be sensitive to the unspoken words of group members. Some need coaxing and encouragement to participate or to express their feeling. In a large group the process of setting priorities is easier to handle by dividing the members into smaller, specialized sub-groups, each dealing with an issue of particular interest or one in which members have special expertise. When the

subgroups rejoin for a final justification, the values in each matrix can be debated and revised if desired.

The debate could be eliminated and individual opinions taken by questionnaire. The final values are derived from the geometric mean of the judgments. Recall that to compute the geometric mean, the values are multiplied and a root equal to the number of individuals who provided the values is taken. For example, he geometric mean of 2, 3 and 7 is $\sqrt[3]{2 \times 3 \times 7}$, which is 3.48 (3 in the pairwise comparison scale).

Taking the geometric mean of individual judgments is one way to solve a lack of consensus on values after debate. Another method of resolving conflict is to vote on the proposed values. The final solution can also be obtained as a range of values that represent the range of judgments.

The AHP does not subvert or force human nature. There is no guarantee that all aspects of dissent can be harnessed, nor should they be. Dissent is a valuable basic process that should not be banned in a group interaction. But dissent must eventually lead to some kind of cooperation if anything is to be accomplished" {35}.

## 4-3 The Decision Support System

### 4-3-1 Introduction

The human mind is a mysterious tool of the human's body that makes decisions in mysterious but systematic ways. Basic instincts, preferences, environmental factors, and an individual's previous experience are factors that influence the human mind. This causes it to make biased decisions. There is no way to remove these factors from human decision-making, but we can employ a framework to help make more logical and less biased decisions, taking our feelings and intuition into consideration. The Expert Choice

version 9.5 is a practical tool for the implementation. The E C system is a valuable and flexible software package for performing multiple-criteria decision analysis, with its capacity to conduct massive computations.

Expert Choice (EC9.5) is a powerful software tool based on the Analytic Hierarchy Process (AHP). It assists the decision-makers in solving complex problems involving many criteria and several alternatives. It organizes the various factors of a problem into an upside-down tree hierarchy. Its solution to a problem reflects the expertise of the decision-maker, not the computer. The judgments of decision makers form the basis of the Expert Choice evaluation process, and the decision-maker makes true logical decisions using the helps of Expert Choice to make an informed choice based on his knowledge, experience and preferences.

Expert Choice is also useful for establishing a forum for discussion in a group decision making processes. It permits the full range of the considerations to be taken into account briefly and comprehensively.

Expert Choice (EC9.5) serves as an excellent tool for communicating a recommended decision to other levels within the organization. It replaces the lengthy paper reports with a brief EC report containing not only the overall decision, but the detailed considerations and judgments that lead to that final decision. In addition to providing the overall priorities for the decision alternatives, EC has the capability of doing "what if" types of analyses, where the decision maker can begin to learn how the overall priorities for the decision alternative are affected by changes in the preference input data.

The Expert Choice (EC9.5) software is currently being applied in hundreds of business operations and government decision applications, including total quality management, resource allocation, cost benefit analysis, engineering design evaluations, selecting alternatives "what-if" forecasting, and product research and development, among others.

### 4-3-2 The Theory Behind Expert Choice

The decision-making is often difficult because tradeoffs must be made among competing objectives, and in order to make tradeoffs, we must be able to evaluate and measure each aspect of the decision—some quantitative, some qualitative and very important, and some not so important. Uncertainties and competing interest groups also add to the complexity of decision making. This complexity is minimized by the use of EC based on the Analytic Hierarchy Process, (AHP). Making effective decisions in the face of complexity can be significantly increased using Expert Choice.

Expert Choice is based on the Analytic Hierarchy Process, (AHP), a methodology for decision making that was developed by the mathematician Thomas L. Saaty at the Wharton School of the University of Pennsylvania. The AHP makes it possible to deal with both tangible and intangible factors. It organizes the data, thoughts, and intuition in a logical, hierarchical structure. It can express our understanding and experience with pairwise comparisons about the relative importance, preference or likelihood of all relevant factors. The AHP accommodates uncertainty and allows for revision so that individuals and groups can grapple with all their concerns, and the results are easily tested for sensitivities to changes in assumption and judgments.

# CHAPTER FIVE
# THE RESEARCH METHODOLOGY

# 5 CHAPTER -FIVE - THE RESEARCH METHODOLOGY

## 5-1 Introduction

The main objectives of this research were first of all to identify the major A/E selection criteria that must be considered by the Saudi Public owners when considering the engagement of a consultant (A/E) for professional services. The second objective of this research is using these selection criteria and the Analytic Hierarchy Process (AHP) to develop a consultant conceptual selection model (**CCSM**) to solve the A/E selection problems in Saudi Arabia. The CCSM will help the public sector in prequalifying and selecting the most qualified A/E "financially capable and technically strong". In addition the average rank and the importance-index of each factor "criteria" were calculated (Figure 5-1).

## 5-2 Data Collection

The main sources for the required data for this research were the previous studies conducted on consultant selection (A/E), the prevailing or current selection practice in Saudi Arabia, and the direct interviews conducted with the public sector construction professionals performing A/E prequalification and selection.

## 5-3 Survey

The approach system taken to achieve the two main objectives of this research was by conducting the survey and interviews as follows:

### 5-3-1 STAGE ONE

In an attempt to achieve the first objective of this research, the data was gathered for formulating the questionnaire form part I (Appendix-D) in three steps:

**Step1:** The available literature on the consultants' prequalifications and selection methods were comprehensively searched and studied to identify the major selection criteria (Table 5-1). These criteria were described in Chapter Two (Section 3-2).

**Step2:** In addition data were gathered through direct interviews with construction professionals in the public sector and a sample of consultants.

**Step3:** Samples of the public sector pre-qualification and selection processes (Appendix-C) were examined to gather additional data and to check the selection criteria used by the public sector organizations in their selection methods.

### 5-3-2 STAGE TWO

The selection criteria that were identified in stage one were used as a basis for formulating the questionnaire form part I (Appendix-D. Since there was no research done in Saudi Arabia in the field of "A/E selection", a small pilot study was conducted involving a sample of public sector representatives and consultants. The main objectives of this were:

- To make sure that the important A/E selection criteria were identified, and comprehensively covered.
- To add more possible important criteria that were not included.
- Finalize the questionnaire form Part I.

**Table 5-1** Identified A/E Selection Criteria

| No | **Description of the A/E Selection Criteria** |
|---|---|
| 1 | Current Work Load |
| 2 | Experience |
| 3 | Experience in Geographical Area |
| 4 | Economic Constraints |
| 5 | Firm Capacity |
| 6 | Firm Organization |
| 7 | Head Office Location |
| 8 | Past Performance |
| 9 | Project Management Capability |
| 10 | Quality Performance |
| 11 | References |
| 12 | Staffs and / Qualification. |
| 13 | Quality Control |

### 5-3-3 STAGE THREE

In this stage two steps were conducted:

**Step1:** First, the questionnaire form (part I) shown in Appendix D was distributed to the thirty public agencies with approved budgets (Appendix-F). Also thirty consultants were included in the survey. They were asked to rate the selection criteria in order of importance, and to add any criteria they might consider be important to the A/E selection process.

**Step2:** Second, two of the public sector organizations (PSO1 and PSO2) were selected to fill in their judgements of criteria and alternatives in the forms part II, and III (Appendix-D). These forms were used as pairwise comparison matrices. This data was used for CCSM's implementation as indicated in section (5-7).

## 5-4 Scoring Method

Since the Analytic Hierarchy Process (AHP) was used in the development of the model, the respondents had nine options for rating the criteria. These options were identical to the scale used by the AHP (Table 4-1). The options were as follows:

| Intensity of Importance | Definition |
|---|---|
| 1 | Equal importance |
| 3 | Moderate importance |
| 5 | Strong importance |
| 7 | Very strong or demonstrated importance |
| 9 | Extreme importance |
| 2,4,6,8 | For compromise between the above values |

The Average Rank (A.R), and Importance Index (I.I) of the identified A/E selection criteria were calculated as follows:

$$\text{Average Rank (A.R)} = [\sum_{i=1}^{n} (ai \cdot Xi) / n] \qquad \text{Eq.5.1.}$$

$$\text{Average Rank (A.R)} = (0x1) + (0x2) + (0x3) + (0x4) + (15x5) + (25x6) + (40x7) + (10x8) + (0x9) / (0+0+0+0+15+25+40+10+0) = 6.5.$$

$$\text{Importance Index (I.I)} = [\sum_{I=10}^{9} (ai \cdot Xi) / n] \text{ X } 100\% \qquad \text{Eq.5.2.}$$

Where: ai = constant expressing the weight given to i th response, i = 1,2,3,4,5,6,7,8,9.

Xi = the variable expressing the frequency of the i th response, for i = 1,2,3,4... and illustrated as follows:

X1 = 1 = the frequency of "Equally important"

X2 = 2 = the frequency of "Equally to moderately important".

X3 = 3 = the frequency of "Moderately important"

X4 = 4 = the frequency of "Moderately to strongly important ".

X5 = 5 = the frequency of "Strongly important".

X6 = 6 = the frequency of "Strongly to very strongly important".

X7 = 7 = the frequency of "Very strongly important".

X8 = 8 = the frequency of "Very strongly to extremely important".

X9 = 9 = the frequency of "Extremely important".

Importance Index (I .I) = (Average Rank / 9) *100 = (6.5/9) x 100 = 72.2%

**Figure 5-1** Method of Calculating the Average Ranks (A.R) and Importance index (I.I).

| No | Criteria | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | A.R | I.I |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Number of Participants Marked | | | | | | | | | | |
| 5 | CR5 | 0 | 0 | 0 | 0 | 15 | 25 | 40 | 10 | 0 | 6.5 | 72.2 |

Accordingly, if all parties answer any criteria by "Equally important" then the Importance Index is = 1, which means that this criterion is not so relevant and is the last in the rank. On the other hand, if all answered by "Extremely important" then the Importance Index is = 9 and means that this is the most important criterion and the first in the rank.

Consequently, the A/E selection criteria were ranked in descending order according to their average ranks. As a result, three lists were obtained, namely the public sector's list, and a consultant's list, and a third list which represents the opinion of the two parties together.

Finally, the agreement between the public sector and the consultants was measured quantitatively using the rank correlation theory. The rank correlation coefficient was calculated as follows:

$$\mathbf{Rho} = 1 - \{ ( 6\sum D^2) / N(N^2-1) \} . \qquad \text{Eq. 5-2}$$

Where:

D = Difference between the ranks given by the public sector and the rank given by the A/Es for individual criteria.

N = Number of the criteria, which in our case is 13.

## 5-5 Sample Size

In this research, the questionnaire was distributed to Public Sector agencies and the sample of the consultants. In the selection process, there were two restrictions, namely;

- To public sector agencies with approved budgets.
- To the consultants practicing in Saudi Arabia.

In this research, the population was divided into two strata:

- Stratum I: The Public Sector Agencies.
- Stratum II: The Consultants.

For Stratum I, the survey included 30 of the public sector departments.

For Stratum II, the A/Es' sample size to be surveyed was represented by thirty consultants (15 from Dammam, and 15 from Riyadh). The selected consultants have had a large volume of work with the public sector and the semi-public. This means a good supply and reliable information was gathered.

A total of 49 completed questionnaires were received back from the public sectors and the consultants. This represents 82% of the total distributed questionnaires. Table 5-2 shows the total sample and the respondents. The names and addresses of the participants are shown in appendix-D.

**Table 5-2:** Number of participants in the survey.

| NO. | Description | No. of questionnaires | | | Percentage |
|---|---|---|---|---|---|
| 1 | Total No. of the questionnaires that were handed out. | 60 | PS | A/E | 100 |
| | | | 30 | 30 | |
| 2 | Total No. of questionnaires complete and returned. | 49 | PS | A/E | 82 |
| | | | 26 | 23 | |
| 3 | Total No. of respondents who did not return questionnaire. | 11 | PS | A/E | 18 |
| | | | 4 | 7 | |

## 5-6 Development of Conceptual Model for A/E Selection (CCSM)

To achieve the second objective of this research, the A/E selection criteria were identified and then these identified criteria were modified (as required) to suit A/E selection in Saudi Arabia. The final identified criteria, the Analytic Hierarchy Process (AHP), and computerized software " **Expert Choice Version 9.5**" based on AHP were used to develop the conceptual A/E Selection Model (**CCSM**). The significance of using the computer was simply to avoid excessive manual computation.

## 5-7 Application of CCSM Model

The conceptual consultant A/E selection (**CCSM**) model was implemented by surveying Saudi industry experts (in the public sector) to show the consistency and completeness of the model for A/E selection. The survey involved two public owners involved heavily in A/E selection for professional services. The two organizations were asked to fill in their judgments in the pairwise comparison matrices. The judgmental data was entered in the pairwise comparison matrices (Appendix- D), and hence were used to calculate the priorities of the model's alternatives.

# CHAPTER SIX
# THE DATA ANALYSIS AND RESULTS

# 6 CHAPTER- SIX- THE DATA ANALYSIS AND RESULTS

## 6-1 Introduction

The questionnaire form part I used in the survey (Appendix D) was used to collect the data pertaining to the A/E selection criteria process, and the common and the important criteria used by the public sector organizations in Saudi Arabia. The participants (Public Sector Organizations and Consultants) were asked to rate the importance of the selection criteria. The participants were kindly requested to add in any criteria that might be important for the evaluation of A/E selection. Table 6-4 shows the total responses that were received.

The collected data from the survey was analyzed. This chapter explains how the data from the survey were analyzed, and discusses the results of this analysis. The important and major A/E selection criteria were thus identified. This accomplished the first objective of the research.

## 6-2 Statistical Methods

In this study, the analysis of the data and results were presented by using the following statistical methods:

### 6-2-1 Statistical Techniques

The questionnaire form "part I" contained the 13 A/E selection criteria. For such criteria, Table 6-1 presents results of the statistical techniques. The statistical techniques included the following statistical methods:

1. The Weighted Mean comprised mainly the average (arithmetical mean), which was calculated following the method explained in Chapter 5 (5-4), and the equation (6.1).

$$\text{Average Rank (A.R)} = X = [\sum_{i=1}^{n} (ai \cdot Xi) / n] \qquad \text{Eq.6.1.}$$

Where:

ai = constant expressing the weight given to i th response , i = 1,2,3,4,5,6,7,8,9.

Xi = the variable expressing the frequency of the i th response, for i = 1,2,3,4.

2. Standard Deviation was used in the arithmetical calculations required for later data analysis.

$$S_x = (\sum_{I=1}^{9} (W_h)^2 * (S_h)^2)^{1/2} \qquad \text{Eq. 6-1 (Levin, 1980)}$$

Where:

$W_h$ = $N_h / N$.

$S_x$ = Standard Deviation of the sample.

$S_h^2$ = $(\bar{X}_{hi} - X_h)^2$.

N = sample size.

3. Standard Error of Mean was used to describe the deviation of sample mean around their population mean.

$$S_x(\bar{X}) = S_x / (N)^{1/2} \qquad \text{Eq. 6-2 (Levin, 1980).}$$

Where:

$S_x$ ($\bar{X}$) = Sample Mean

N = Sample size.

4. 95% confidence Interval

The samples may not be a perfect indication of the population from which they are drawn. This means that we may never be sure how close the sample value is to the population value. While data from the sample would not determine the exact

population value, yet this data can be used to estimate a value or an interval that is considered to contain the population value. The sample value is called a point estimate and this interval is called a confidence interval and its size depends on the degree of confidence desired in the sample results by the researcher. The confidence coefficient used in this study is 95% unless otherwise mentioned. This means that the 0.95 of the area under the curve is where we would accept the null hypothesis, and the remaining 0.05 area is where we would reject the null hypothesis. In other words, if a large number of probability samples were taken, 95% of these samples would contain the actual mean of the universe within an interval of {1.96 SE (X)}.

$$95\%\ \text{confidence Interval} = \bar{X} \pm 1.96\,(\bar{X}) \qquad \text{Eq. 6-3 (Levin, 1980)}$$

where:

$\bar{X}$ = sample standard error of mean.

For example, the criterion number two (CR2- Experience) has the following 95% confidence intervals:

$$8.19 \pm (1.96 * 0.11)$$

This yield means:

The Lower Limit (LL) = 8.41

The Upper Limit (UL) = 7.96

According to the (1- 9) scale used in the analysis of the data (see Fig.6-1)

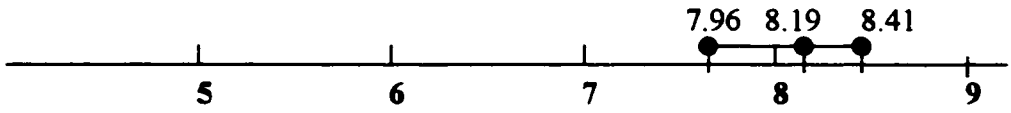



**Fig. 6.1** Upper and Lower limits

5. Coefficient of Variation

Coefficient of variation is a relative measure of the precision of the estimator (Public Sector or Consultant). It shows the magnitude of the deviation relative to the magnitude of the mean.

$$C.V. = (S_x / \bar{X}) \times 100\% \qquad \text{Eq. 6.4}$$

(Levin, 1980)

Where:

| | | |
|---|---|---|
| C.V. | = | Coefficient of Variation |
| $S_x$ | = | Standard deviation |
| X | = | Sample mean |

### 6-2-2 Ranking

The measurement of the importance of each criterion was determined by the calculation of the average rank of each criterion. The methodology of calculating was explained in Chapter 5 (Section 5-4). Then, the criteria were ranked according to the highest average rank and the importance index.

Table 6-2 expresses the importance of the criteria to the public sector. This is represented by the public sector opinion in ranking the criteria.

Table 6-3 shows the results of the ranks of the criteria with respect to the consultants' opinions.

Table 6-4 shows the results of the ranks of the criteria with respect to all parties. The total respondents for each criterion are also shown in the same tables

**Table 6-1** STATISTICAL TECHNIQUES USED IN THE ANALYSIS OF THE DATA.

| NO. | Criteria Description | MEAN | STD | STD ERROR OF MEAN | VAR | COEFF. OF VARIATION CV | 95% CONFIDENCE INTERVAL | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | LOWER LIMIT | UPPER LIMIT |
| CR.1 | Current Work Load | 6.93 | 1.23 | 0.17 | 1.50 | 17.71 | 6.60 | 7.25 |
| CR.2 | Experience | 8.19 | 0.83 | 0.11 | 0.68 | 10.09 | 7.96 | 8.41 |
| CR.3 | Experience in Geographic Location | 6.09 | 1.33 | 0.18 | 1.78 | 21.89 | 5.74 | 6.45 |
| CR.4 | Economical Constraints | 6.44 | 1.77 | 0.24 | 3.12 | 27.41 | 5.97 | 6.92 |
| CR.5 | Firm Capacity | 6.11 | 1.74 | 0.24 | 3.04 | 28.55 | 5.65 | 6.58 |
| CR.6 | Firm Organization | 6.52 | 1.75 | 0.24 | 3.05 | 26.78 | 6.05 | 6.98 |
| CR.7 | Head Office Location | 5.52 | 2.01 | 0.27 | 4.03 | 36.37 | 4.98 | 6.05 |
| CR.8 | Past Performance | 7.37 | 1.48 | 0.20 | 2.20 | 20.12 | 6.97 | 7.77 |
| CR.9 | Project Management Capability | 7.31 | 1.52 | 0.21 | 2.30 | 20.71 | 6.91 | 7.72 |
| CR.10 | Quality Performance | 8.06 | 1.07 | 0.15 | 1.15 | 13.30 | 7.77 | 8.34 |
| CR.11 | References | 7.63 | 0.90 | 0.12 | 0.80 | 11.75 | 7.39 | 7.87 |
| CR12 | Staff and Qualification | 8.15 | 0.90 | 0.12 | 0.81 | 11.03 | 7.91 | 8.39 |
| CR.13 | Quality Control | 7.69 | 0.89 | 0.12 | 0.79 | 11.53 | 7.45 | 7.92 |

**Table 6-2** Summary Report of Questionnaire Part I "Public Sector".

| Rank | No. | Criteria Description | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Average Rank | Importance Index |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | NUMBER OF RESPONSES | | | | | | | | | | |
| 8 | CR.1 | Current Work Load | 0 | 0 | 0 | 0 | 2 | 6 | 10 | 2 | 6 | 7.15 | 79.49 |
| 2 | CR.2 | Experience | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 10 | 14 | 8.38 | 93.16 |
| 12 | CR.3 | Experience in Geographic Location | 0 | 0 | 0 | 0 | 4 | 10 | 6 | 6 | 0 | 6.54 | 72.65 |
| 11 | CR.4 | Economical Constraints | 0 | 0 | 0 | 0 | 8 | 6 | 4 | 4 | 4 | 6.62 | 73.50 |
| 10 | CR.5 | Firm Capacity | 0 | 0 | 0 | 0 | 4 | 10 | 2 | 6 | 4 | 6.85 | 76.07 |
| 9 | CR.6 | Firm Organization | 0 | 0 | 0 | 0 | 4 | 6 | 6 | 4 | 6 | 7.08 | 78.63 |
| 13 | CR.7 | Head Office Location | 0 | 2 | 2 | 0 | 4 | 4 | 12 | 2 | 0 | 5.92 | 65.81 |
| 5 | CR.8 | Past Performance | 0 | 0 | 0 | 0 | 0 | 4 | 2 | 12 | 8 | 7.92 | 98.29 |
| 4 | CR.9 | Project Management Capability | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 14 | 8 | 8.00 | 88.89 |
| 3 | CR.10 | Quality Performance | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 16 | 8 | 8.23 | 91.45 |
| 7 | CR.11 | References | 0 | 0 | 0 | 0 | 2 | 2 | 10 | 10 | 2 | 7.31 | 81.20 |
| 1 | CR12 | Staff and Qualification | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 10 | 14 | 8.46 | 94.02 |
| 6 | CR.13 | Quality Control | 0 | 0 | 0 | 0 | 0 | 2 | 14 | 4 | 6 | 7.54 | 83.76 |

**Table 6-3** Summary Report of Questionnaire Part I "Consultants".

| Rank | No. | Criteria Description | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Average Rank | Importance Index |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | NUMBER OF RESPONSES | | | | | | | | | | |
| 7 | CR.1 | Current Work Load | 0 | 0 | 0 | 0 | 4 | 8 | 12 | 0 | 4 | 6.71 | 74.60 |
| 1 | CR.2 | Experience | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 12 | 8 | 8.00 | 88.89 |
| 11 | CR.3 | Experience in Geographic Location | 0 | 0 | 3 | 0 | 12 | 4 | 4 | 4 | 0 | 5.67 | 62.96 |
| 9 | CR.4 | Economical Constraints | 0 | 0 | 4 | 4 | 0 | 4 | 8 | 4 | 4 | 6.29 | 69.84 |
| 12 | CR.5 | Firm Capacity | 0 | 0 | 8 | 0 | 4 | 8 | 4 | 4 | 0 | 5.43 | 60.32 |
| 10 | CR.6 | Firm Organization | 0 | 0 | 4 | 4 | 4 | 0 | 8 | 8 | 0 | 6.00 | 66.67 |
| 13 | CR.7 | Head Office Location | 0 | 0 | 12 | 0 | 4 | 4 | 4 | 0 | 4 | 5.14 | 52.69 |
| 6 | CR.8 | Past Performance | 0 | 0 | 0 | 0 | 12 | 0 | 0 | 12 | 4 | 6.86 | 85.71 |
| 8 | CR.9 | Project Management Capability | 0 | 0 | 0 | 4 | 4 | 4 | 4 | 9 | 3 | 6.68 | 74.21 |
| 3 | CR.10 | Quality Performance | 0 | 0 | 0 | 0 | 4 | 1 | 0 | 12 | 11 | 7.89 | 87.70 |
| 2 | CR.11 | References | 0 | 0 | 0 | 0 | 0 | 1 | 4 | 19 | 4 | 7.93 | 88.10 |
| 4 | CR12 | Staff and Qualification | 0 | 0 | 0 | 0 | 0 | 4 | 4 | 12 | 8 | 7.86 | 87.30 |
| 5 | CR.13 | Quality Control | 0 | 0 | 0 | 0 | 0 | 0 | 12 | 9 | 7 | 7.82 | 86.90 |

**Table 6-4** Summary Report of Questionnaire Part 1 "All Parties".

| Rank | No. | Criteria Description | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Average Rank | Importance Index |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | NUMBER OF RESPONSES | | | | | | | | | | |
| 8 | CR.1 | Current Work Load | 0 | 0 | 0 | 0 | 6 | 14 | 22 | 2 | 10 | 6.93 | 76.95 |
| 1 | CR.2 | Experience | 0 | 0 | 0 | 0 | 0 | 2 | 8 | 22 | 22 | 8.19 | 90.95 |
| 12 | CR.3 | Experience in Geographic Location | 0 | 0 | 3 | 0 | 16 | 14 | 10 | 10 | 0 | 6.09 | 67.71 |
| 10 | CR.4 | Economical Constraints | 0 | 0 | 4 | 4 | 8 | 10 | 12 | 8 | 8 | 6.44 | 71.60 |
| 11 | CR.5 | Firm Capacity | 0 | 0 | 8 | 0 | 8 | 18 | 6 | 10 | 4 | 6.11 | 67.90 |
| 9 | CR.6 | Firm Organization | 0 | 0 | 0 | 0 | 8 | 6 | 24 | 12 | 6 | 7.04 | 78.17 |
| 13 | CR.7 | Head Office Location | 3 | 2 | 14 | 0 | 8 | 8 | 16 | 2 | 4 | 5.28 | 58.67 |
| 6 | CR.8 | Past Performance | 0 | 0 | 0 | 0 | 12 | 4 | 2 | 24 | 12 | 7.37 | 81.89 |
| 7 | CR.9 | Project Management Capability | 0 | 0 | 0 | 4 | 4 | 8 | 4 | 23 | 11 | 7.31 | 81.28 |
| 3 | CR.10 | Quality Performance | 0 | 0 | 0 | 0 | 4 | 1 | 2 | 28 | 19 | 8.06 | 89.51 |
| 5 | CR.11 | References | 0 | 0 | 0 | 0 | 2 | 3 | 14 | 19 | 6 | 7.55 | 83.84 |
| 2 | CR12 | Staff and Qualification | 0 | 0 | 0 | 0 | 0 | 4 | 6 | 22 | 22 | 8.15 | 90.53 |
| 4 | CR.13 | Quality Control | 0 | 0 | 0 | 0 | 0 | 2 | 26 | 13 | 13 | 7.69 | 85.39 |

### 6-2-3 Correlation

Correlation analysis is the statistical tool that can be used to describe the degree to which variables are linearly related to another. One of the methods of measuring the correlation is to determine the correlation coefficient (r). Correlation coefficient (r) is used to find the degree of the relationship existing among different factors or parties. In this research, the objective was to determine the degree of rank correlation between public sector organizations and consultants. The Spearman correlation method was the most suitable method for this study. Spearman rho ranges from –1 to +1. The +1 means perfect correlation, the –1 means inverse correlation, and 0 means no correlation exists between the two parties. The following formula was used in the calculation the coefficient of rank correlation:

$$r_s = 1 - [6 \Sigma d^2 / N (N^2 - 1)] \qquad \text{Eq. 6.5}$$

(Levin, 1980)

Where:

$r_s$ = the coefficient of rank correlation

d = Difference between the rank of one variable and to rank of other variable.

N = Number of criteria (Number of pairs of ranks).

By applying the above formula (6-5) and the use of Table 6-5, the degree of agreement in rank between the public sector organizations and the consultants was determined by the calculation of the coefficient of rank correlation ( $r_s$ ) which was calculated as follows:

$$r_s = 1 - [6 \Sigma d^2 / N (N^2 - 1)]$$

$$r_s = 1 - [6*64 / 13 (13^2 - 1)]$$

$$r_s = 1 - [384/2184]$$

$$r_s = 0.8242$$

The above result out coefficient of rank correlation ( $r_s = 0.8242$ ) indicated a strong agreement between both the public sector organizations and the consultants. The coefficient of rank correlation of 0.8242 indicated positive direction. The small difference in rank between the public sector and the consultants can be appreciated by realizing the difference in the experience level of participants' personnel.

Figure 6-2 Spearman Correlation Coefficient

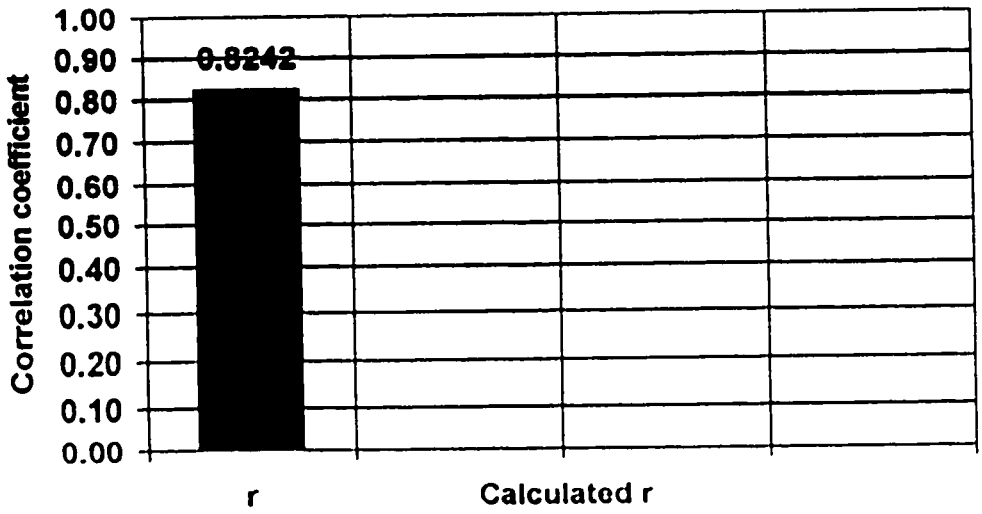


**Table 6-5** SPEARMAN CORRELATION.

| No. | Criteria Description | RANKING BY | | DIFFERENCE BETWEEN RANK | |
|---|---|---|---|---|---|
| | | Public Sector | Consultants | D | D*D |
| CR.1 | Current Work Load | 8 | 7 | 1 | 1 |
| CR.2 | Experience | 2 | 1 | 1 | 1 |
| CR.3 | Experience in Geographic Location | 12 | 11 | 1 | 1 |
| CR.4 | Economical Constraints | 11 | 9 | 2 | 4 |
| CR.5 | Firm Capacity | 10 | 12 | -2 | 4 |
| CR.6 | Firm Organization | 9 | 10 | -1 | 1 |
| CR.7 | Head Office Location | 13 | 13 | 0 | 0 |
| CR.8 | Past Performance | 5 | 6 | -1 | 1 |
| CR.9 | Project Management Capability | 4 | 8 | -4 | 16 |
| CR.10 | Quality Performance | 3 | 3 | 0 | 0 |
| CR.11 | References | 7 | 2 | 5 | 25 |
| CR12 | Staff and Qualification | 1 | 4 | -3 | 9 |
| CR.13 | Quality Control | 6 | 5 | 1 | 1 |
| $\sum D^*D$ | | | | | 64 |

## 6-3 Satisfaction of the Restriction

The research study is limited to the A/E selection process among the public sector organizations in Saudi Arabia. To avoid getting faulty and unrealistic responses, the selected organizations of public sector were approach personally by explaining the main objectives of the research, the proposed A/E selection criteria, and the proposed rating system. The questionnaire forms were kept simple, and were to be handled by the top management personnel within the public sector and consultants.

## 6-4 Statistical Results

The data analysis resulted in three main statistical results:

### 6-4-1 Coefficient of Variation

The participants (public sector organizations and consultants) provided responses with variation between 10 and 37%. The data is considered to be homogenous when the coefficient of variation (C.V.) is less than 10%. However, the variation in the provided responses was somewhat large. This is due to the differences in the level of experience of participants' top level management that influenced the participants' input. Therefore the predictive values must be considered with care, and the results of this study applied only to the A/E selection process for public construction projects.

### 6-4-2 Ranking

Besides the "business criteria" that requires any A/E office practices consultancy in Saudi Arabia to satisfy the Ministry of Commerce requirements "Registration and

Licensing", the 13 A/E selection criteria were ranked according to the resulting importance indices as shown in tables 6-2, 6-3, and 6-4.

There were some suggested criteria by the participants. The researcher examined the suggested criteria to be sub-criteria that are included within the major criteria described in Chapter Three "A/E Selection Criteria".

The data analysis results and Table 6-2 show that the major and the most important A/E selection criteria as ranked by the public sector were:

- Staff and Qualifications.
- Experience.
- Quality Performance.
- Project Management Capability.

Regardless of the selection method used, the above mentioned factors were ranked the most important criteria because of the major control they impose on the selection process. These factors were followed by less influential factors including:

- Past Performance.
- Quality Control.
- References.
- Current Work Load.
- Firm Organization.
- Firm Capacity.

The lowest ranked and unused criteria were:

- Economic Constraints.
- Experience in Geographical Area.
- Head Office Location.

Table 6-6 shows that the consultants agreed in general with public sector in the rank and the importance of the A/E selection criteria. The small differences in ranks of

selection criteria confirmed the strong agreement on the importance of the 13 criteria to the selection process.

The differences in ranks of project management capability criteria is due to the current concern and desire by the public sector to establish and evaluate the project management professionalism among the consultant staff. The public sector willingness to benefit as much as possible from the project management practice, and the fact that project management capability is a major factor that plays a major role in the improvement of the consultancy practice and the success of the project.

The high rank of staff and qualification criteria confirms that the public sector considers "Staff and Qualification Criteria" to be the most important criteria that must be evaluated if proper and successful A/E selection. This criterion is the basic foundation for any positive indication that might be realized for A/E. An A/E success, experience, reputation, and qualifications are entirely based on educated, qualified, and well trained staff. The absence of qualified and experienced staff compares the A/E with a blacksmith without charcoal.

The public sector ranked "References" seventh among the thirteen selection criteria. They are not satisfied with the quality of the information provided regarding references. They believe that consultants' references are not quite updated, and outdated information is usually included.

Unlike the United States of America, the Saudi public sector organizations believe strongly that Experience in Geographical Area, and Head Office Location are not such important criteria to the A/E selection process in Saudi Arabia. This is due to the small and closed Saudi geographical location, the country's identical provinces, the identical codes and regulations, and the fact that a selected A/E is required to visit the project's site to know more about the project's location to gather all the information required to accomplish the work.

Finally, the public sector considers that the "Economical Constraints" criterion is not as applicable to the A/E selection process in Saudi Arabia as it is to the

construction contractors. The A/E economical constraints can be evaluated through visiting A/E office. No public sector' organization indicated that A/E is required to submit a financial statement for evaluation. However, the case is different when considering selecting a **design/build team** for both design and construction of public projects. The design/build team's financial statement would be carefully examined in order to establish team credibility.

**Table 6-6** Criteria as Ranked by Public Sector and Consultants.

| Ranking by Public Sector | The A/E Selection Criteria Description | Ranking by Consultants |
|---|---|---|
| 1 | CR12 Staff and Qualifications | 4 |
| 2 | CR2 Experience | 1 |
| 3 | CR10 Quality Performance | 3 |
| 4 | CR9 Project Management Capability | 8 |
| 5 | CR8 Past Performance | 6 |
| 6 | CR13 Quality Control | 5 |
| 7 | CR11 References | 2 |
| 8 | CR1 Current Work Load | 7 |
| 9 | CR6 Firm Organization | 10 |
| 10 | CR5 Firm Capacity | 12 |
| 11 | CR4 Economical Constraints | 9 |
| 12 | CR3 Experience in Geographic Location | 11 |
| 13 | CR7 Head Office Location | 13 |

### 6-4-3 Correlation

The statistical analysis's third result was a strong agreement between the public sector and consultants in ranking the selection criteria in terms of importance to the selection process. This was indicated by the coefficient of rank correlation ($r_s$) of 0.8242 calculated by equation 6.5 Section (6-2-3). The resulted strong correlation ($r_s$) was then supported by the hypothesis test.

In this research, the **Hypothesis Test** was conducted as follows:

a.) The statement of the hypothesis was as follows:

**Ho : = 0 null hypothesis: there is no agreement between public sector and consultants.**

**Ho : ≠ 0 alternative hypothesis: there is agreement between public sector**

**and consultants.**

**0.05 = the significance level for testing the hypothesis.**

b.) N = 13 Sample size (Number of Criteria being compared).

The sample size in our case is smaller than 30. Therefore the distribution of $r_s$ is not normal, and the appropriate way to test hypothesis is to use the Appendix (E) determine the upper and lower limits **( ± 1.96 (X))**.

c.) The critical test value was obtained from Appendix (E):

**$t_{0.05}$ = 0.5549**

From the calculated coefficient of rank correlation ($r_s$ ) of 0.8242, it was observed that $r_s$ = 0.8242 is larger than the critical value $t_{0.05}$= 0.5549. This means that the rank correlation coefficient ($r_s$) lies in the rejected region.

Therefore, the null hypothesis Ho: r = 0 "No correlation" is rejected, concluding that there is strong rank correlation between public sector and consultants in ranking the selection criteria.

## 6-5 Current A/E Selection Practice

The literature search and interviews conducted with both the public sector and consultants indicated that competitive selection process is currently the most widely used method among public sector organizations. Regardless of the selection method used, the A/E fee is considered to be a major deciding factor that usually finalizes the selection process.

## 6-6 A/E Selection Criteria

As the results of the interviews conducted and the analysis of data indicate, the identification of the selection criteria which are accounted to be the major factors influencing the A/Es' selection process in Saudi Arabia ***"THE RESEARCH'S FIRST OBJECTIVE"*** was accomplished. The following criteria were identified and found to be the most important and common used A/E selection criteria as ranked by the public sector:

- ***STAFF AND QUALIFICATIONS.***
- ***EXPERIENCE.***
- ***QUALITY PERFORMANCE.***
- ***PROJECT MANAGEMENT CAPABILITY.***
- ***PAST PERFORMANCE***
- ***QUALITY CONTROL***

- ***REFERENCES***
- ***CURRENT WORK LOAD***
- ***FIRM ORGANIZATION***
- ***FIRM CAPACITY***
- ***ECONOMICAL CONSTRAINTS***
- ***EXPERIENCE IN GEOGRAPHICAL AREA***
- ***HEAD OFFICE LOCATION***

# CHAPTER SEVEN
# THE DEVELOPMENT OF CONSULTANT CONCEPTUAL SELECTION MODEL

# 7 CHAPTER SEVEN -THE DEVELOPMENT OF A/E CONSULTANT CONCEPTUAL SELECTION MODEL ( CCSM )

## 7-1 Introduction

The literature reviews and the physical interviews resulted in the positive conclusion that public sector is in need of a consistent methodology that will insure the proper and successful A/E selection for public projects considering the A/E ability and qualifications as well as the project's specific risk factors. The method must be comprehensive, flexible, simple in performance, easy to review, adaptable for both individual and group, and does not require inordinate specialization to master and communicate. The needed methodology can be formulated by the development of an A/E consultant conceptual selection model (**CCSM**). This chapter discusses the development and testing of the A/E Consultant Conceptual Selection Model (**CCSM**).

## 7-2 Recommended A/E Selection Criteria

The similarities between some criteria call for the combination of related criteria into one that can be considered for evaluating the A/E ability during the selection process. The percentage of weight of each criterion was used to determine the total weight for the combined selection criteria. The percentage of weights of criteria obtained (Table 7-1) were calculated as follows:

$$\text{Total Average Rank ( A.R.)} = \text{Summation of the Ranks} = \sum_{I=1}^{I=13} (\text{A.R.}) \qquad \text{Eq. 7.1}$$

( Al-Gobali 1994)

$$\text{Weight of Criteria} = \text{Criteria Average Rank } (C_{A.V}) \,/ \sum_{I=1}^{I=13} (\text{A.R.}) \qquad \text{Eq. 7.2}$$

( Al-Gobali 1994)

Where some criteria are not required, these unwanted criteria can be omitted and a new sum of total average rank of the remaining selection criteria can be recalculated. Then new weights of the remaining criteria will be calculated based on the newly calculated average ranks.

In our study and based on the resulting discussion in Section 6-4-2, Experience in Geographical Location, Economic Constraints, and Head Office Location were not considered and therefore omitted, leaving the criteria shown in table 7-2.

Table 7-3 and Figure 7-1 shows the combined selection criteria and the new total combined weights. The obtained selection criteria were used in conjunction with the Analytic Hierarchy Process (**AHP**) theory to develop the A/E consultant conceptual selection model (**CCSM**).

**Table 7-1** Percentage Weights of Selection Criteria.

| No. | The A/E Selection Criteria Description | Average Rank | % of Weight of Criteria |
|---|---|---|---|
| CR12 | Staff and Qualifications | 8.46 | 8.81 |
| CR2 | Experience | 8.38 | 8.74 |
| CR10 | Quality Performance | 8.23 | 8.57 |
| CR9 | Project Management Capability | 8.00 | 8.33 |
| CR8 | Past Performance | 7.92 | 8.25 |
| CR13 | Quality Control | 7.54 | 7.85 |
| CR11 | References | 7.31 | 7.61 |
| CR1 | Current Work Load | 7.15 | 7.45 |
| CR6 | Firm Organization | 7.08 | 7.38 |
| CR5 | Firm Capacity | 6.85 | 7.14 |
| CR4 | Economical Constraints | 6.62 | 6.89 |
| CR3 | Experience in Geographic Location | 6.54 | 6.81 |
| CR7 | Head Office Location | 5.92 | 6.17 |
| **Total Average Rank** | | **96** | **100** |

**Table 7-2** Research's Recommended Criteria.

| No. | The A/E Selection Criteria Description | Average Rank | % of Weight of Criteria |
|---|---|---|---|
| CR12 | Staff and Qualification | 8.46 | 11.00 |
| CR2 | Experience | 8.38 | 10.90 |
| CR10 | Quality Performance | 8.23 | 10.70 |
| CR9 | Project Management Capability | 8.00 | 10.40 |
| CR8 | Past Performance | 7.92 | 10.30 |
| CR13 | Quality Control | 7.54 | 9.80 |
| CR11 | References | 7.31 | 9.50 |
| CR1 | Current Work Load | 7.15 | 9.30 |
| CR6 | Firm Organization | 7.08 | 9.20 |
| CR5 | Firm Capacity | 6.85 | 8.90 |
| **TOTAL** | | **76.92** | **100** |

**Table 7-3** Combined A/E Selection Criteria.

| No. | Combined Criteria | The A/E Selection Criteria Description | Total Combined % Weight of Criteria |
|---|---|---|---|
| 1 | CR1,CR2 | Work Experience (1,2, ) | 20.20 |
| 2 | CR6,CR9 | Project Management Capability (6, 9) | 19.60 |
| 3 | CR12 | Staff and Qualification | 11 |
| 4 | CR10 | Quality Performance | 10.70 |
| 5 | CR8 | Past Performance | 10.30 |
| 6 | CR13 | Quality Control | 9.80 |
| 7 | CR11 | References | 9.50 |
| 8 | CR5 | Firm Capacity | 8.90 |
| **TOTAL WEIGHT** | | | **100** |

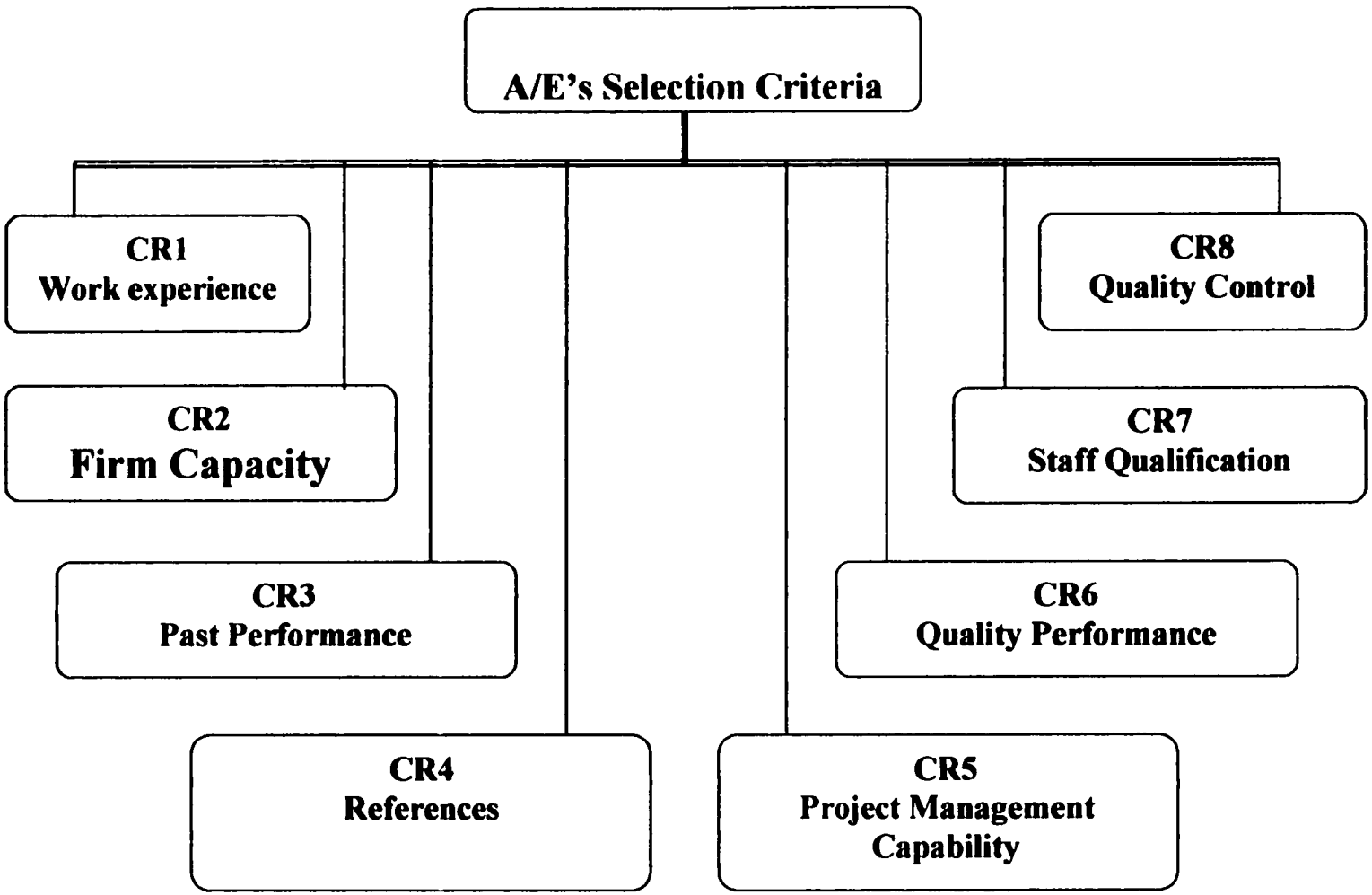



**Figure: 7-1** Schematic of Recommended Criteria for A/E's Selection in Saudi Arabia

## 7-3 The CCSM Model Development

The development of the Consultant Conceptual Selection Model (CCSM) was based on the previously obtained A/E selection criteria (Figure7-1), and Table 7-3 that were identified as a result of literature search, and by examining the prequalification, and selection criteria of the public sector. These criteria were used as main factors that must be considered during the A/E selection process. Careful consideration of these criteria will contribute in establishment of minimum and acceptable requirements, and ultimately lead to the selection of the most qualified A/E. The **CCSM** model's schematic is shown in Figure 7-2. It is a framework that will provide public sector agencies with important and focused constraints that, if understood and considered with proper project's criteria, will successfully determine who should be selected as the most qualified A/E. A detailed description of the main steps of the CCSM model follows.

### 7-3-1 List Selection Criteria

Regardless of owner type, project type, and selection methods used, the A/E selection process utilized requires a predetermined set of "criteria" measures. The A/Es' qualifications will be evaluated against these criteria so that the minimum and acceptable conditions are met for selecting qualified A/E for a proposed project. They will establish a unified and fair evaluation methodology for the proper and successful engagement of A/E. ***Therefore, the first step in the CCSM development is to list the desired selection criteria.***

### 7-3-2 Check for Major and Common Criteria

To ensure the effectiveness of the model, the predetermined criteria must be objective and comprehensive. In order to meet the user's full satisfaction, these criteria

must positively satisfy the main goal of the process "To select the Most Qualified A/E". Comprehensively, they must consider the A/E work experience, qualification, and the project's specific conditions. ***Therefore, an important step in the CCSM development is to examine how major, common, and complete the listed criteria are. They must be comprehensive criteria that will satisfy the selection goal.***

### 7-3-3 Add and Modify Criteria

Depending on the user, project type, and any other specific conditions, the criteria listed can be modified to suit the selection process, and ultimately lead toward a positive and defined direction. They can be increased or shortened as required. ***Therefore, if needed, the listed criteria can be modified as needed to suit and contribute to the execution of the main goal " to select the most qualified A/E".***

### 7-3-4 List Prospective A/Es

Once the selection main measures "Criteria and Sub-Criteria" are identified, ***then the next step in developing the CCSM is to list the candidates available for selection alternatives (the prospective A/Es)***. These alternatives (A/Es) can be obtained by using the predetermined long list of A/Es, or based on invitations directed to a number of A/Es to submit their qualifications and work experience for prequalification. The number of listed A/Es should not be less than five A/Es to conduct wide and fair prequalification.

### 7-3-5 Prequalify for Short List

No matter what selection method may be used for determining the A/Es' long list, some listed A/Es may not meet the preliminary screening requirements of the

selection process. If an A/E fails to meet the preliminary screening requirements, then the A/E will be disqualified in the early stage of prequalification and subsequently removed from the list. Such preliminary screening yields a brief and short list that will be subjected to stringent evaluation against more specific selection criteria to determine the competitiveness of the A/Es. The A/E competitiveness for this CCSM is mainly based on the A/E qualifications and work experience.

### 7-3-6 Apply AHP Model

Because of the complexity of the prevailing selection process in dealing with maybe myriad or endless factors that affect the achievement of goal and consistency of judgements of selecting a qualified A/E, Analytic Hierarchy Process (**AHP**) will be used to solve the selection model. The complexity of the selection process can be handled and best understood by "*applying the principle and techniques of AHP*" breaking it down into its constituent elements, structuring elements hierarchically, and then composing, or synthesizing judgements on the relative importance of the elements at each level of the hierarchy into a set of overall priorities. The highest level is the overall objective " *selecting the most qualified A/E*". The lowest level is the final actions or alternatives "A/Es". The intermediate levels of the hierarchy comprise the selection criteria for evaluating the selection process. This application is detailed by using the computerized decision support system (*Expert Choice, Version ECpro 9.5*) to structure the selection model (Sections 7-4, 8-2, 8-3, 8-4 and Figures 7-1 to 7-22).

### 7-3-7 Test for Consistency

Once the selection problem is completely structured and comparison matrices are developed, ***then examining consistency is a quality control step that must be carried out***. The measurement of consistency ratio (CR) is to be conducted to check if the utilized judgements are consistent enough, and that the decision to come up with a

successful A/E selection is not based on low consistency. Basically, a CR should be 10 percent or less. If it is more than 10 percent, then judgements must be revised as required. This application is explained in Section 8-3.

### 7-3-8 Conduct Pairewise Comparison.

In some cases, CR values are more than 10 percent and the revision of the judgements alone is not good enough to minimize CR values to an acceptable level of consistency. In this case it advisable to go back to check details and the structure of the framework of the hierarchy. It may be necessary to gather more input information and revise as required.

### 7-3-9 Synthesize for Overall Result.

After recording all preferences and important comparing alternatives "A/Es" and criteria with respect to the goal, ***then the next step is to synthesize for the over all result of A/E selection.*** This is achieved by generating the global weights of the nodes by combining the local priorities throughout the entire model. It is the process of converting the local priorities into the global priorities of the selection model, and give the alternatives global weights. The distributive mode is used to perform this synthesis from the goal node to get the overall selection results. The application of overall synthesis and detail are shown in Figures 8-10 to 8-11.

### 7-3-10 Rank A/Es.

As a result of the overall synthesis, ***the distributive synthesis mode prioritizes prospective A/Es with respect to their relative worth***. The distributive synthesis mode can be used to perform the synthesis from the goal node to get the overall selection

results. The distributive synthesis mode ranks the prospective A/Es, placing the most qualified consultant in the top. Unlike the ideal synthesis mode, it allows rank to reverse when a change is made to the priorities. Detail of this application is shown in Figures 8-21, and 8-22.

### 7-3-11 Select A/E

The resulting ranked list of A/Es forms a solid foundation from which to choose the most appropriate A/E firm to perform the required service(s). Those A/Es whose work experiences and qualifications are not compatible with the project's requirements have now been eliminated from the list. Usually it is advisable to pre-select the top four or five most qualified A/Es for an oral presentation and evaluation.

### 7-3-12 Negotiate and Agree with A/E

After the evaluation of oral presentations has been completed, customarily, at least three selected A/Es will make the final selection. Negotiation for signing a contract the follow. The selected A/Es will be ranked first, second, third, and so on. Negotiation begins with the A/E ranked first. During this negotiation the scope of work, contract terms, the detail and structure of the professional fee, and legal and contractual requirements are completely reviewed and included in the discussions. If and when an agreement is reached with the negotiating A/E, then a consultant contract will be prepared for signing to contractually commit the A/E to perform the required services.
If an agreement is not reached with the A/E ranked first, then negotiations with that A/E is terminated and the A/E ranked second is invited for negotiations and so on until an A/E is selected and a satisfactory agreement is reached.

### 7-3-13 Sign A Contract

Finally, when a satisfactory agreement is reached with an A/E firm, signing a contract with that consultant firm (A/E) completes the selection process.

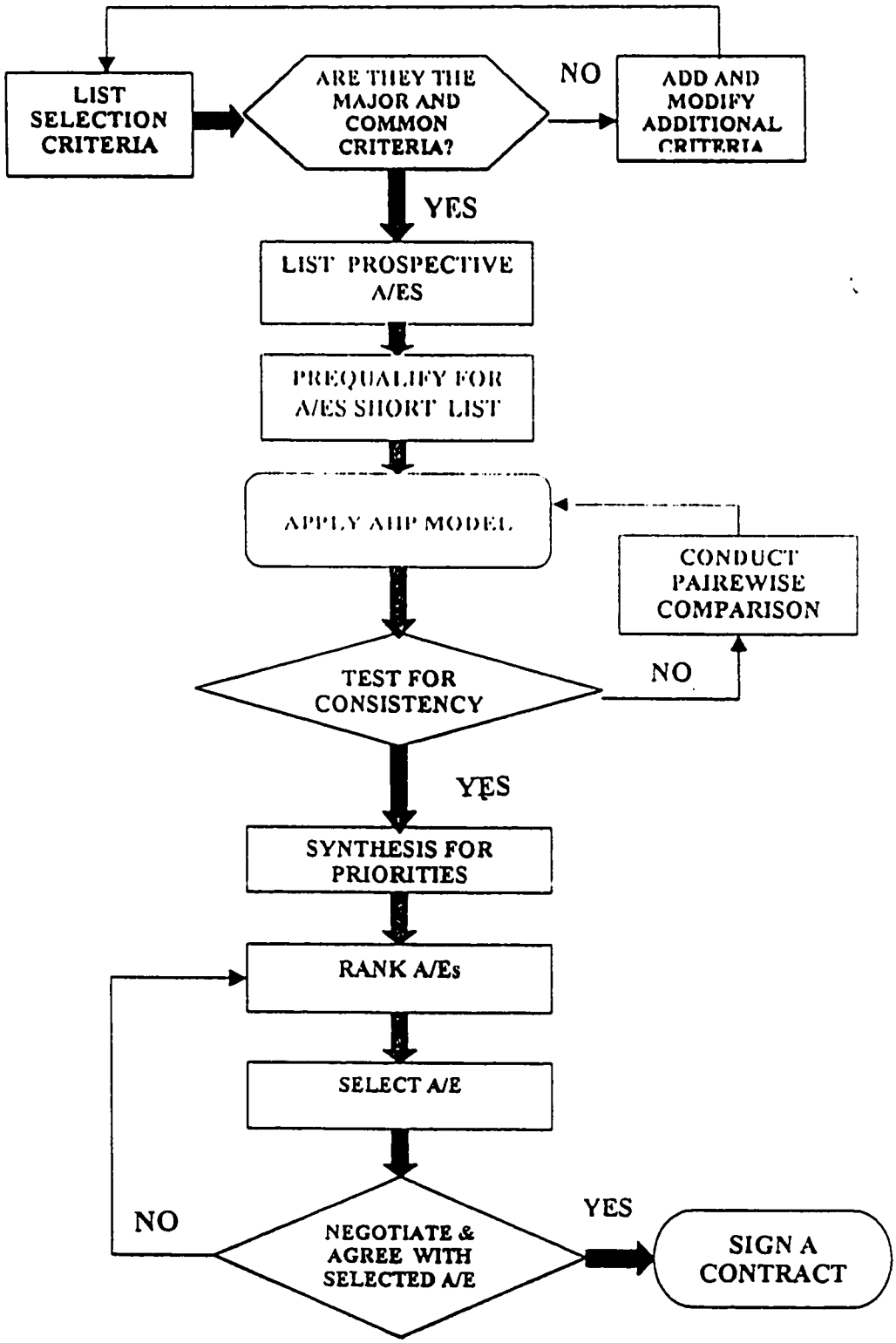



Figure 7- 2 Development of an A/E Consultant Conceptual Selection Model (CCSM).

## 7-4 Structuring a CCSM Model

In this section, the A/E selection criteria which were finaly identified (Figure 7-1), the Analytic Hierarchy Process (**AHP**), and the computerized decision support system (**Expert Choice, Version Ecpro 9.5**) were used to structure a CCSM model. This accomplished the second main objective of the research. The Expert Choice manual instructions were used in structuring the selection model as an upside-down tree hierarchy. The model's name is A/E Consultant Conceptual Selection Model (CCSM) and it consists of three levels. The Expert Choice commands were used for the construction and editing of the selection model. The structure of the model was as follows:

**Model Name:** Using the File/New command the model's name was defined as "A/E Consultant Conceptual Selection Model (CCSM).

**Goal Definition:** "Selecting the Most Qualified A/E" was the model's goal. This is positioned at the top of the model and inserted at level (1) to serve as the goal node of this model.

**Entering Main Criteria:** In the next level (2), the identified criteria (Table 7-4) were inserted to serve as the model's main criteria.

**Entering Alternatives:** Then, finally, the alternatives were inserted in the last level (3) of the hierarchy.

Table 7-4 shows the model nodes and their definitions. The main nodes of the hierarchy were highlighted and printed to give copies of the model showing the model tree for CCSM-PSO1(Figure 7-3 to 7-11). Also a sideways view command was used to display all of the levels of the model (Figure 7-12). The model tree and sideways view for CCSM-PSO2 are displayed in (Figure 7-13 to 7-22).

**Table 7-4** CCSM Model Nodes' Names and Definitions.

| **Node Name.** | **Definition** |
|---|---|
| CR1.WEXP | Work Experience. |
| CR2.FCAP | Firm Capacity. |
| CR3.PPER | Past Performance |
| CR4.REFS | References. |
| CR5.PMC | Project Management Capability. |
| CR6.QPER | Quality Performance. |
| CR7.SQ | Staff and Qualification. |
| CR8.QC | Quality Control. |
| A/E1 | Consultant Number One. |
| A/E2 | Consultant Number Two. |
| A/E3 | Consultant Number Three. |
| A/E4 | Consultant Number Four. |
| A/E5 | Consultant Number Five. |

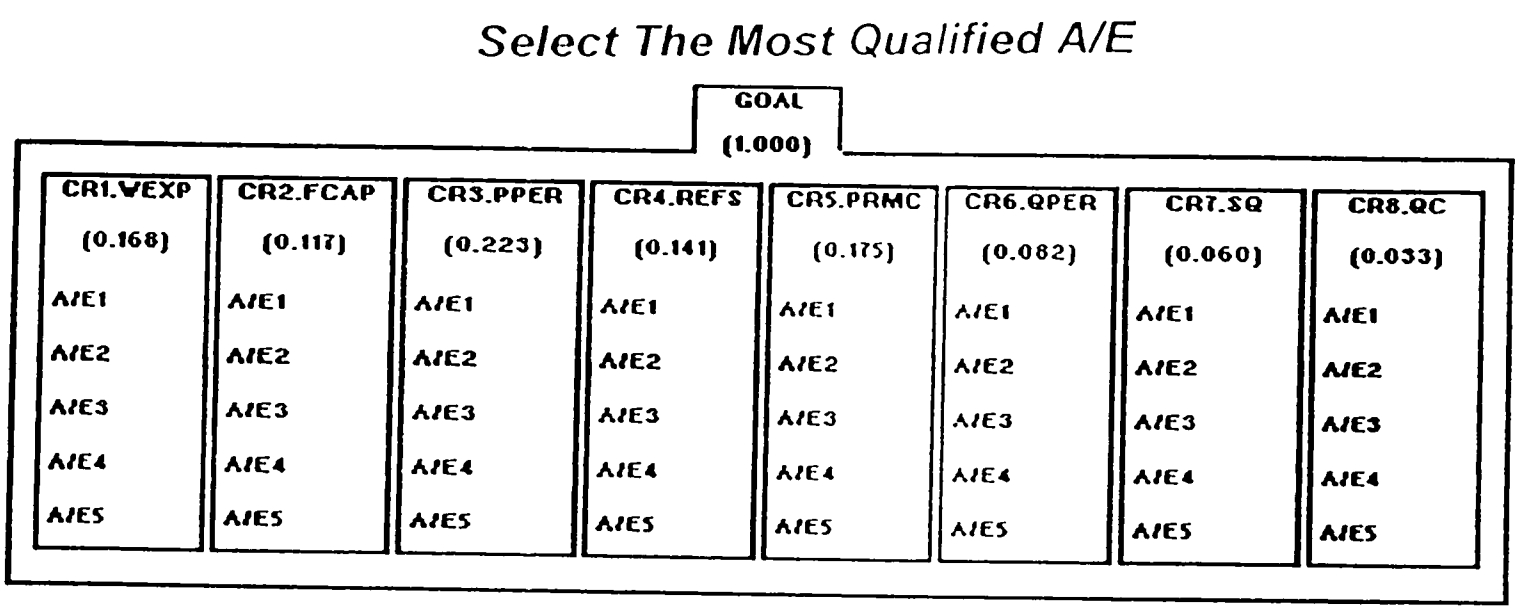



Figure 7-3 The (CCSM-PSO1) Model Displayed From Goal Node.

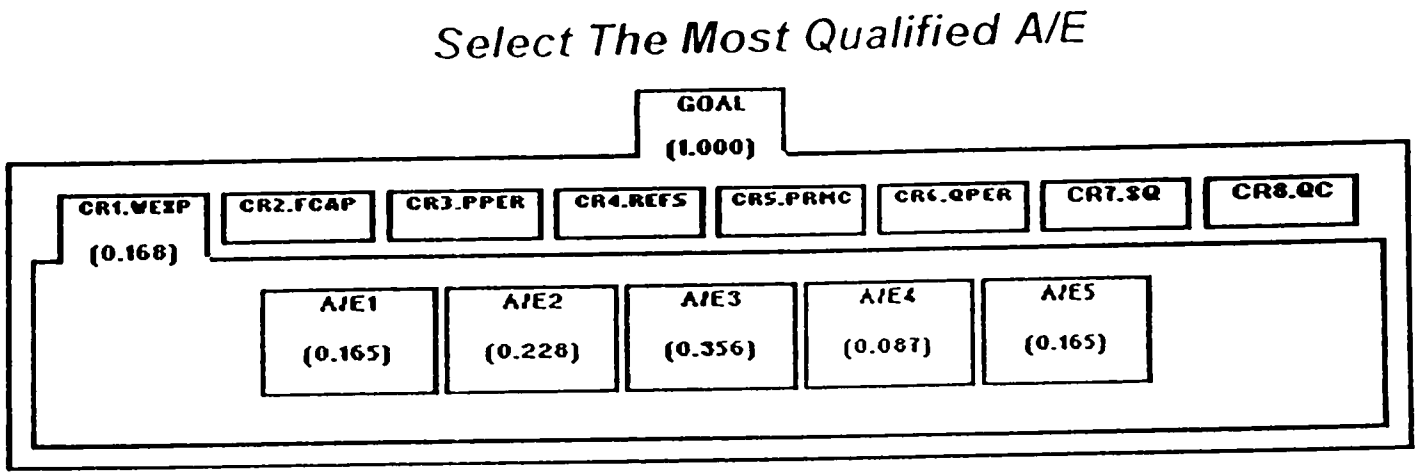



Figure 7-4 The (CCSM-PSO1) Model Displayed From WORK EXPERIENCE (CR1.WEXP) Node.

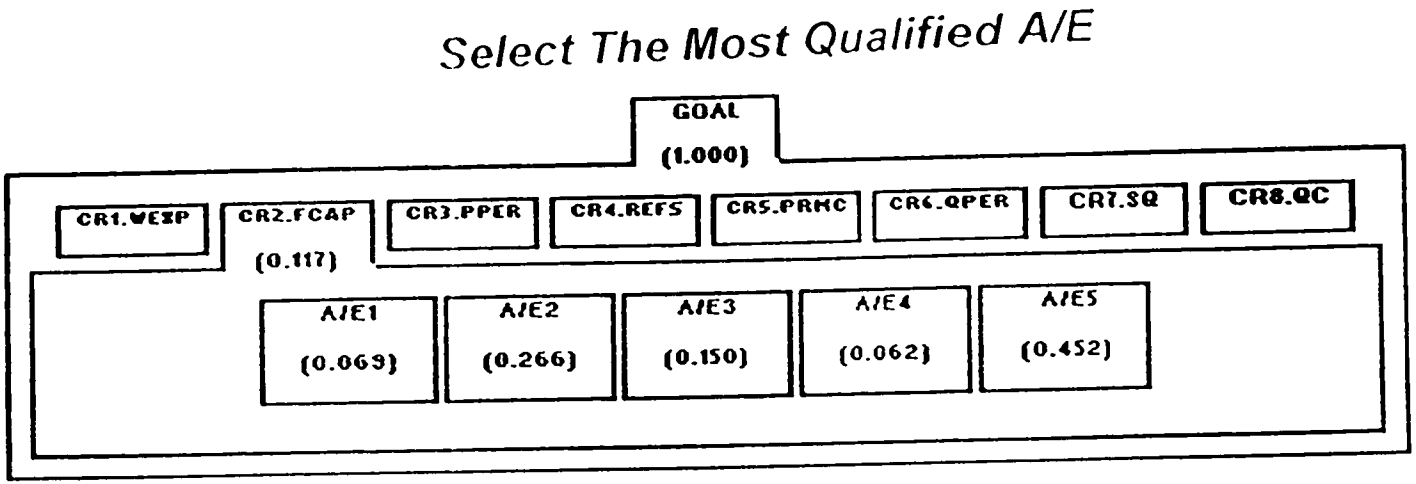



**Figure 7-5** The (CCSM-PSO1) Model Displayed From FIRM CAPACITY (CR2.FCAP) Node.

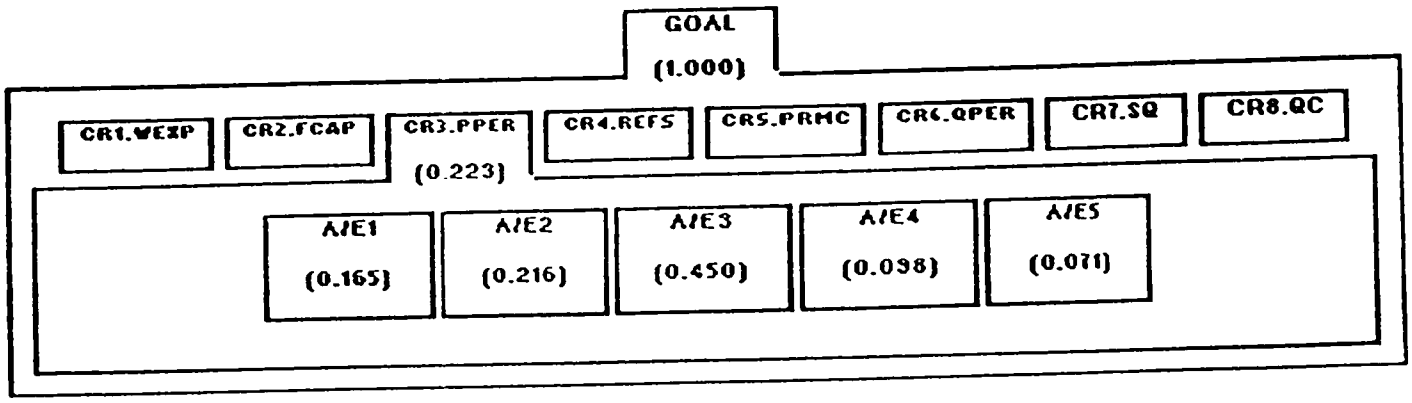



**Figure 7-6** The (CCSM-PSO1) Model Displayed From PAST PERFORMANCE (CR3.PPER) Node

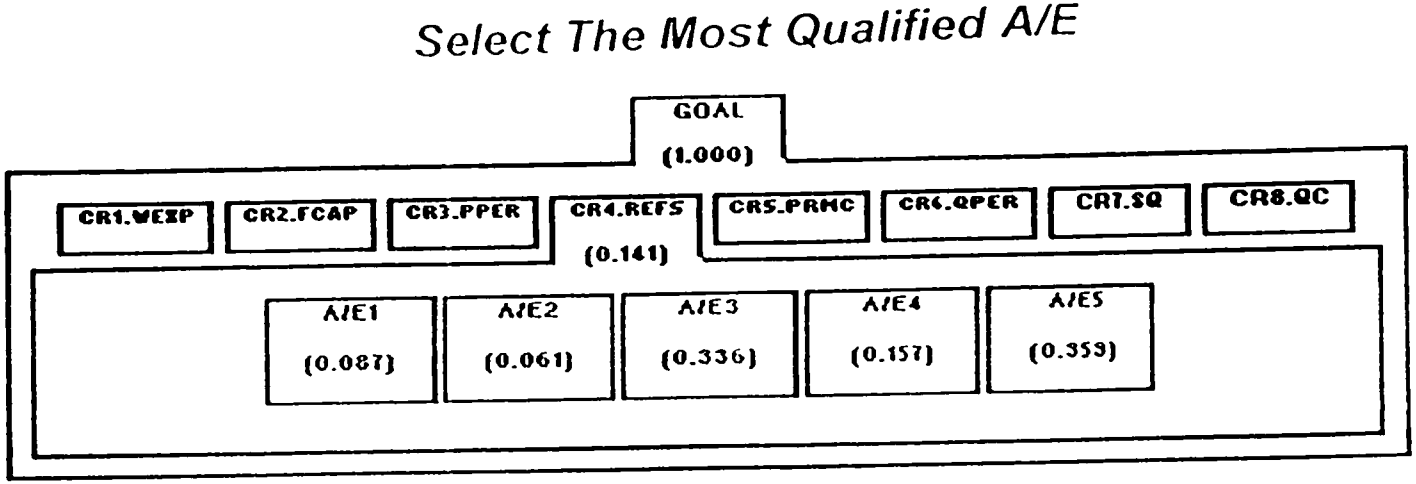



Figure 7-7 The (CCSM-PSO1) Model Displayed From Firm REFERENCES (CR4.REFS) Node.

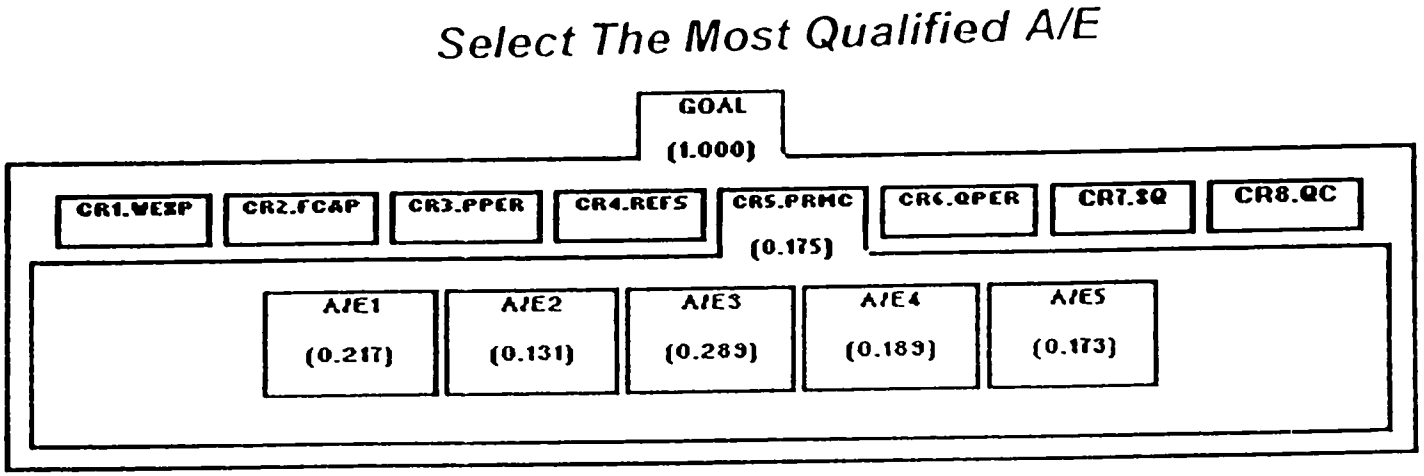



**Figure 7-8** The (CCSM-PSO1) Model Displayed From PROJECT MANAGEMENT CAPABILITY (CR5.PMC) Node.

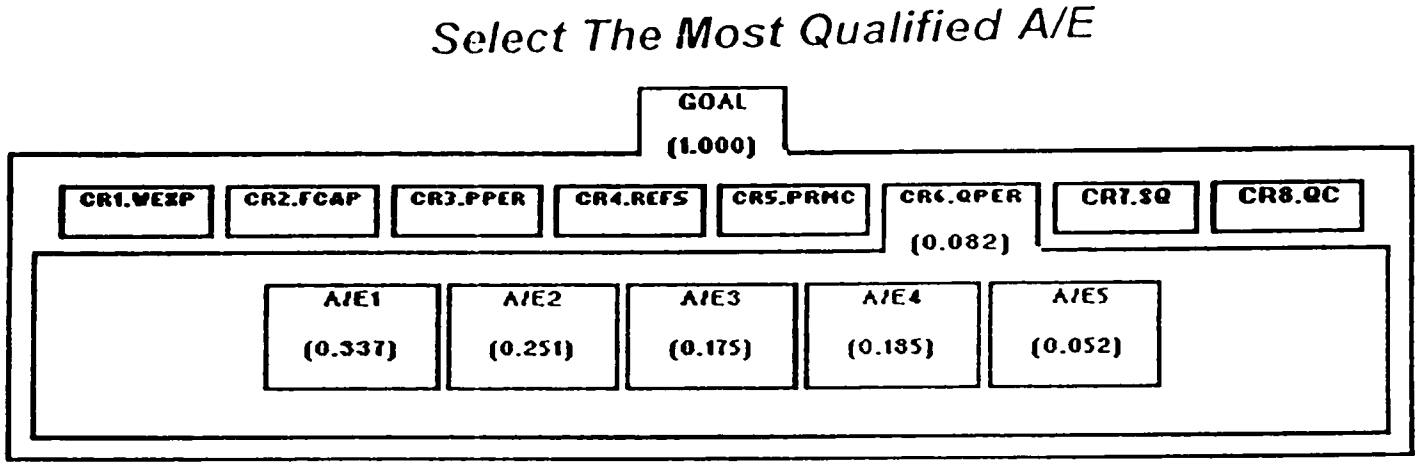



**Figure 7 -9** The (CCSM-PSO1) Model Displayed From QUALITY PERFORMANCE (CR6.QPER) Node

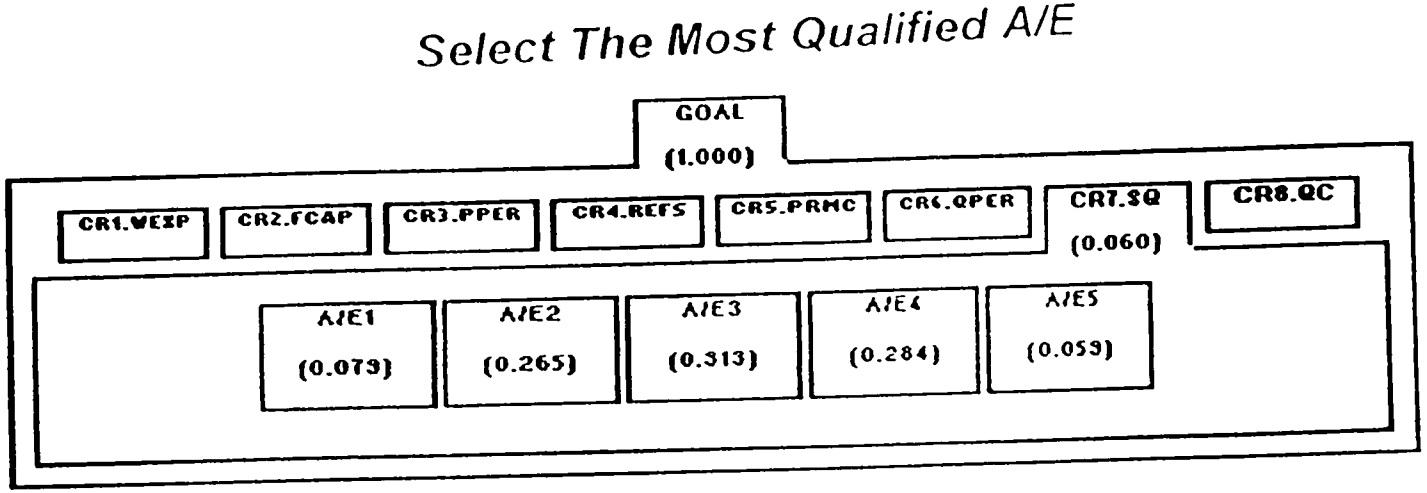



Figure 7-10 The (CCSM-PSO1) Model Displayed From Staff And Qualification (CR7SQ) Node

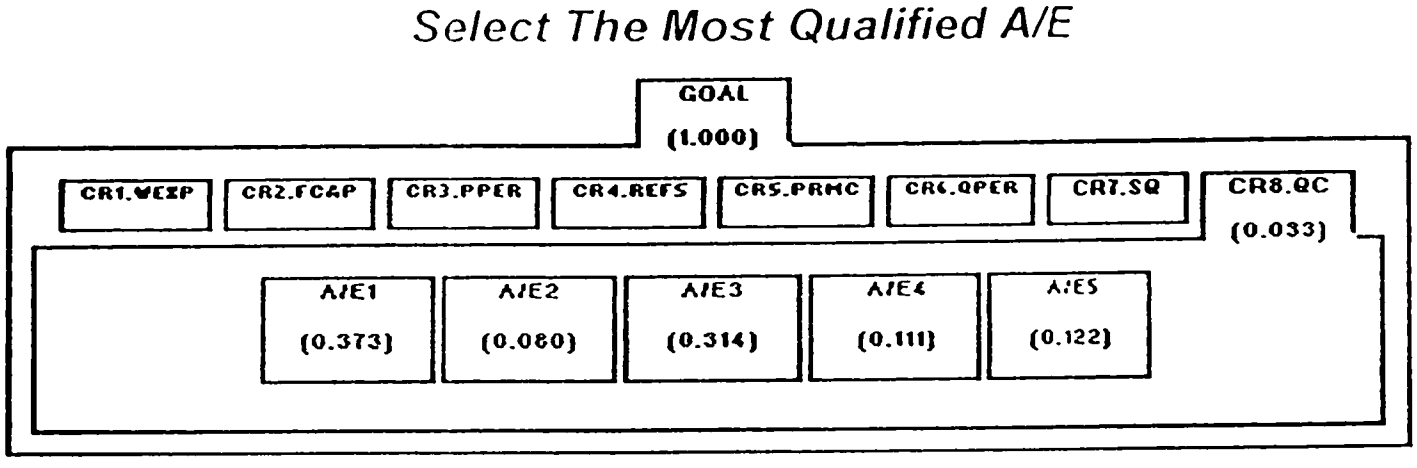
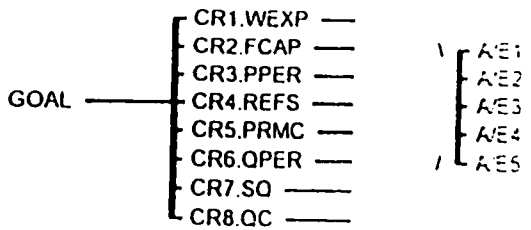



**Figure 7-11** The (CCSM-PSO1) Model Displayed From QUALITY CONTROL (CR8QC) Node




| Abbreviation | Definition |
|---|---|
| GOAL | |
| A/E1 | CONSULTANT NUMBER ONE |
| A/E2 | CONSULTANT NUMBER TWO |
| A/E3 | CONSULTANT NUMBER THREE |
| A/E4 | CONSULTANT NUMBER FOUR |
| A/E5 | CONSULTANT NUMBER FIVE |
| CR1.WEXP | WORK EXPERIENCE |
| CR2.FCAP | FIRM CAPACITY |
| CR3.PPER | PAST PERFORMANCE |
| CR4.REFS | REFERENCES |
| CR5.PRMC | PROJECT MANAGEMENT CAPABILITY |
| CR6.QPER | QUALITY PERFORMANCE |
| CR7.SQ | STAFF AND QUALIFICATIONS |
| CR8.QC | QUALITY CONTROL |

Figure 7-12 Side-Way View Of The (CCSM-PSO1) Model.

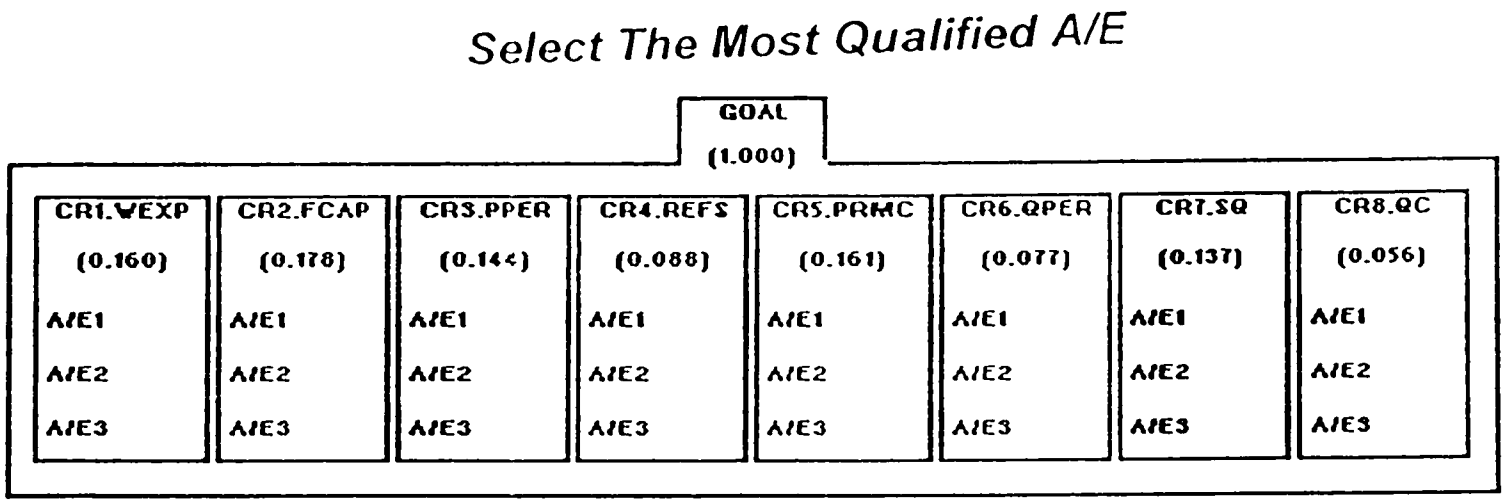



Figure 7-13 The (CCSM-PSO2) Model Displayed From Goal Node

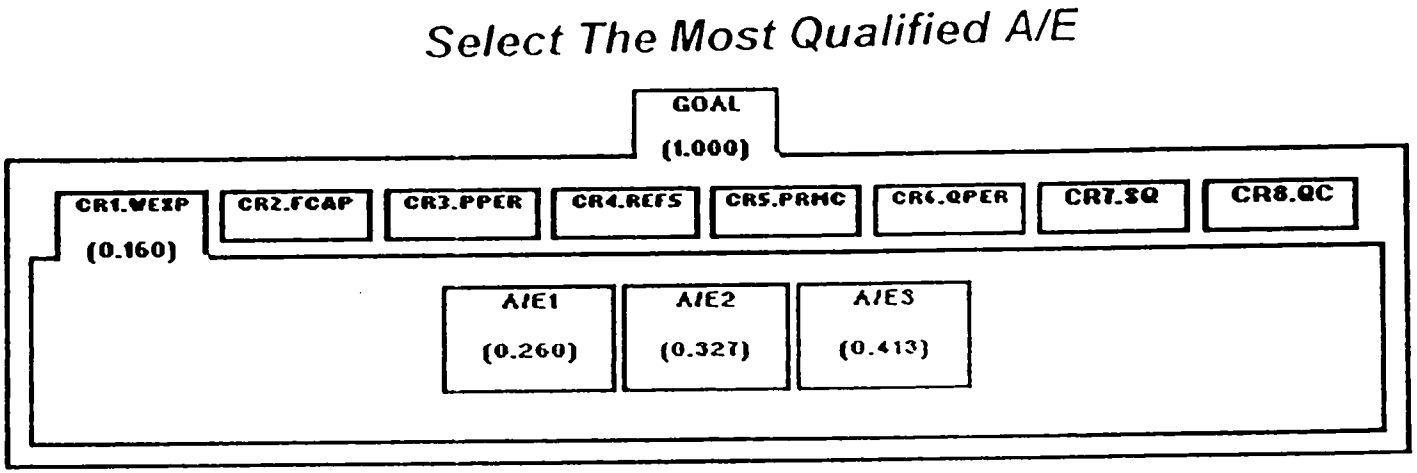



**Figure 7-14** The (CCSM-PSO2) Model Displayed From WORK EXPERIENCE (CR1.WEXP) Node.

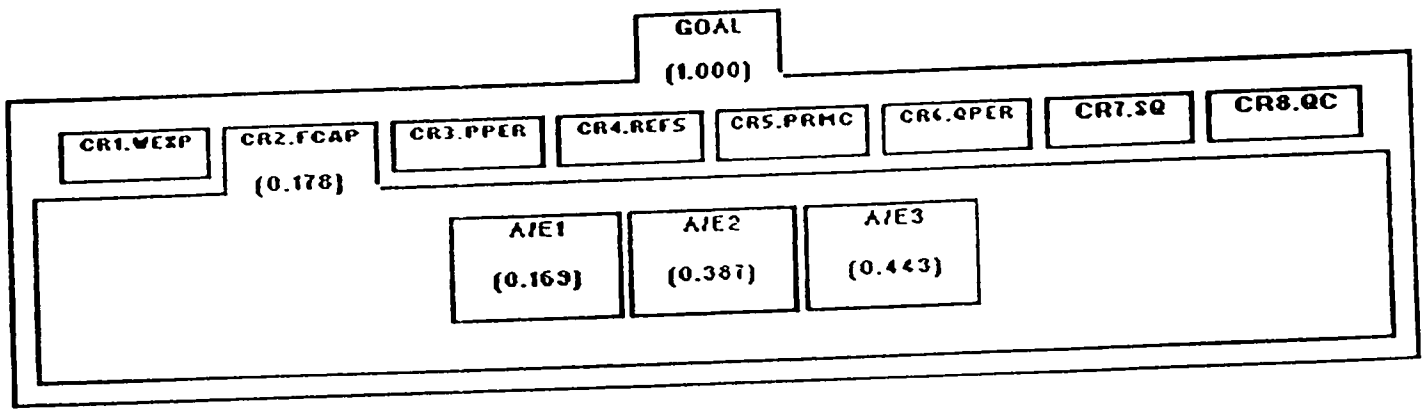



Figure 7-15 The (CCSM-PSO2) Model Displayed From FIRM CAPACITY (CR2.FCAP) Node.

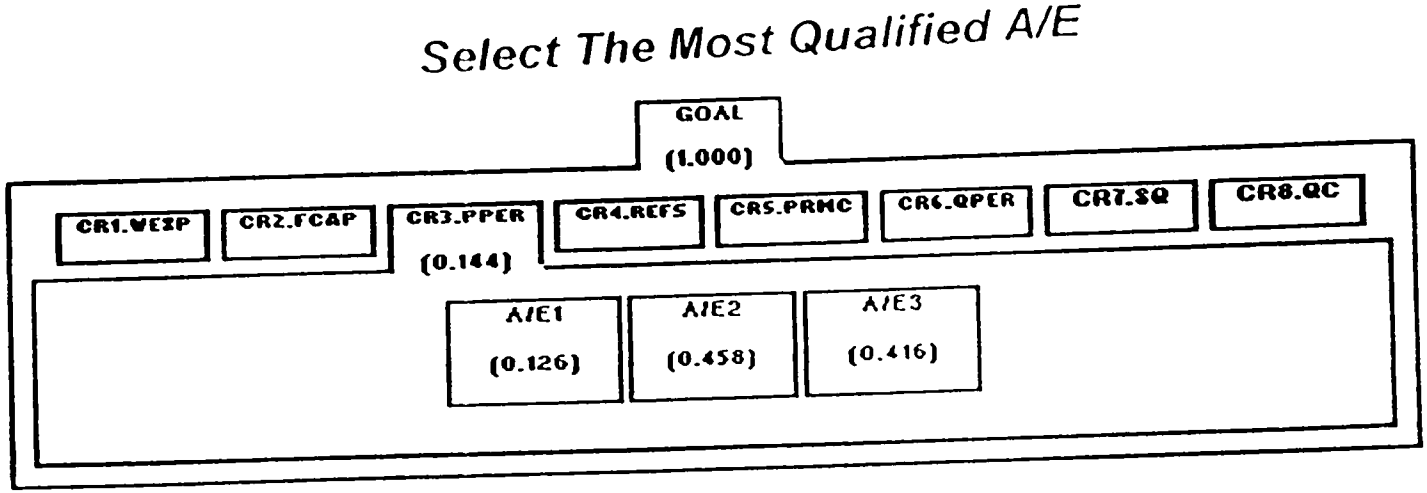



**Figure 7-16** The (CCSM-PSO2) Model Displayed From PAST PERFORMANCE (CR3.PPER) Node.

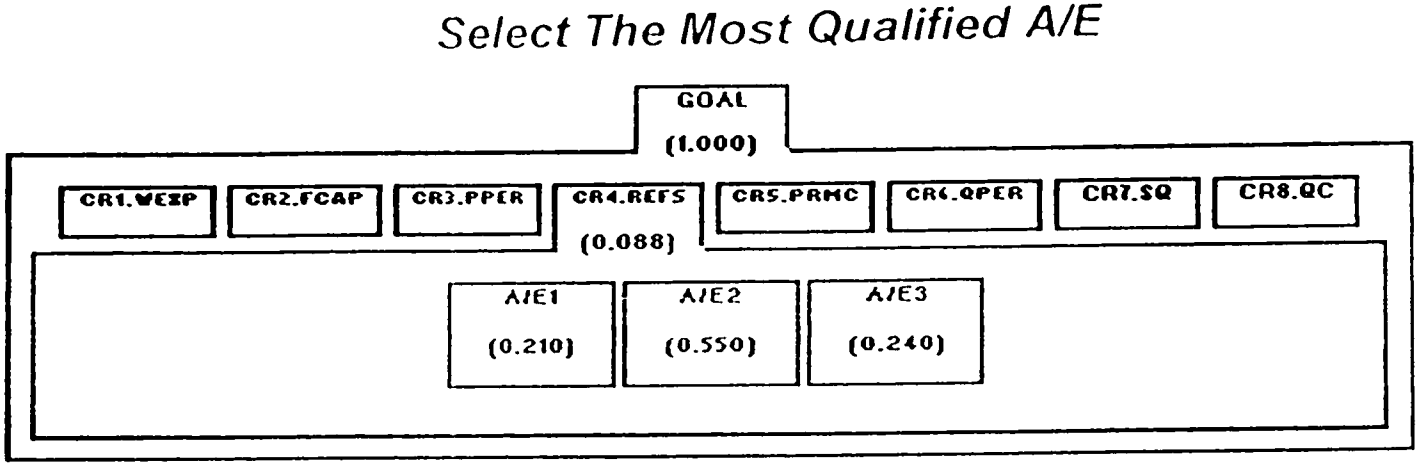



**Figure 7-17** The (CCSM-PSO2) Model Displayed From Firm REFERENCES (CR4.REFS) Node

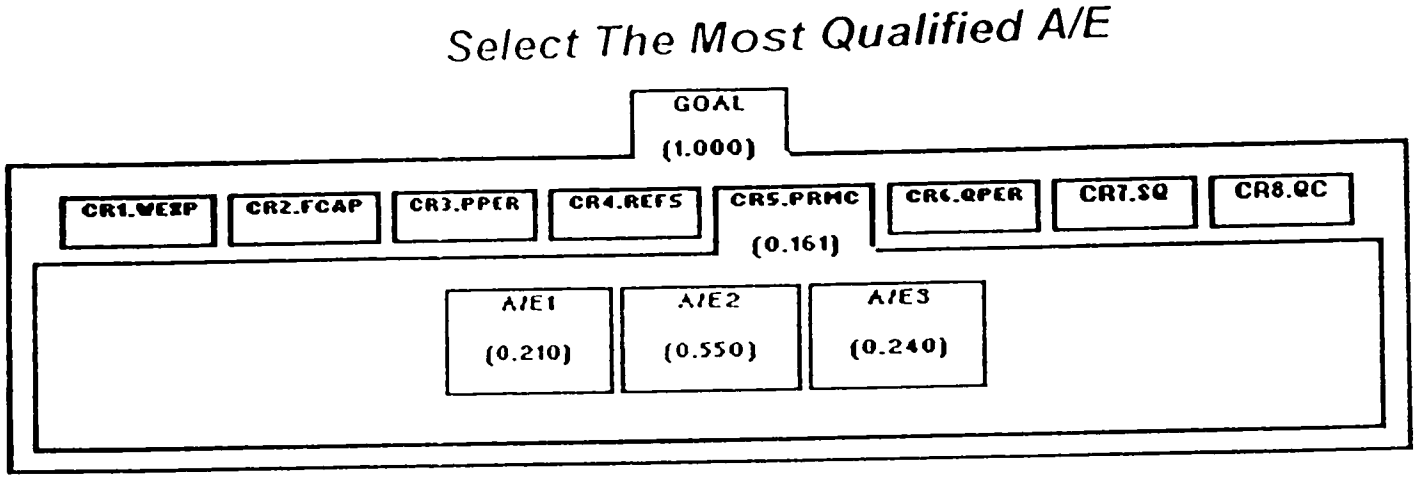



**Figure 7-18** The (CCSM-PSO2) Model Displayed From PROJECT MANAGEMENT CAPABILITY (CR5.PMC) Node.

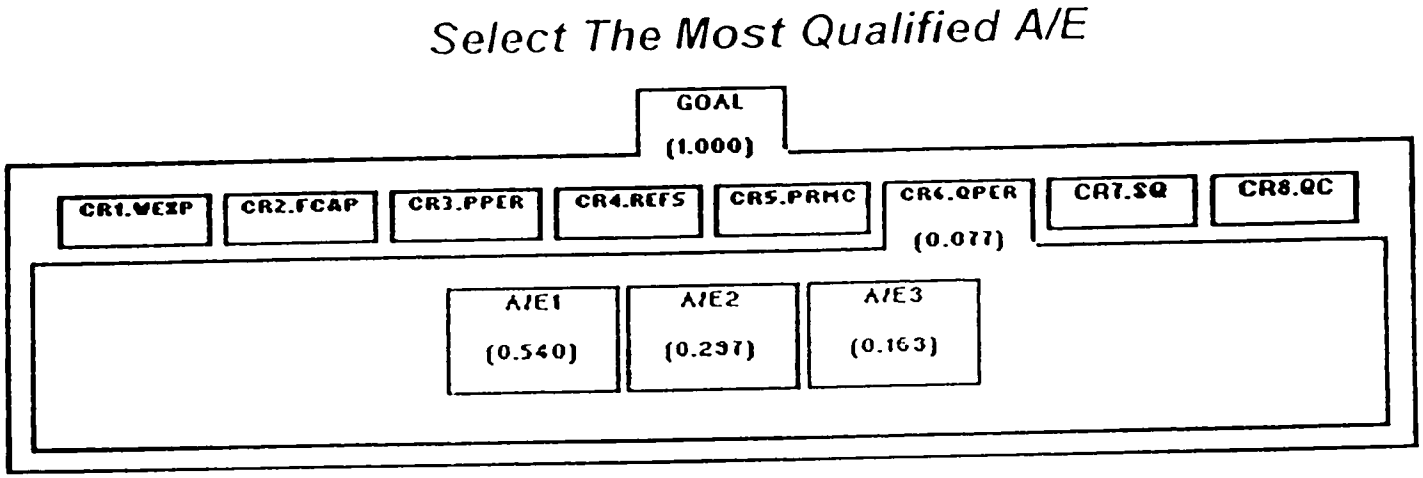



**Figure 7-19** The (CCSM-PSO2) Model Displayed From QUALITY PERFORMANCE (CR6.QPER) Node

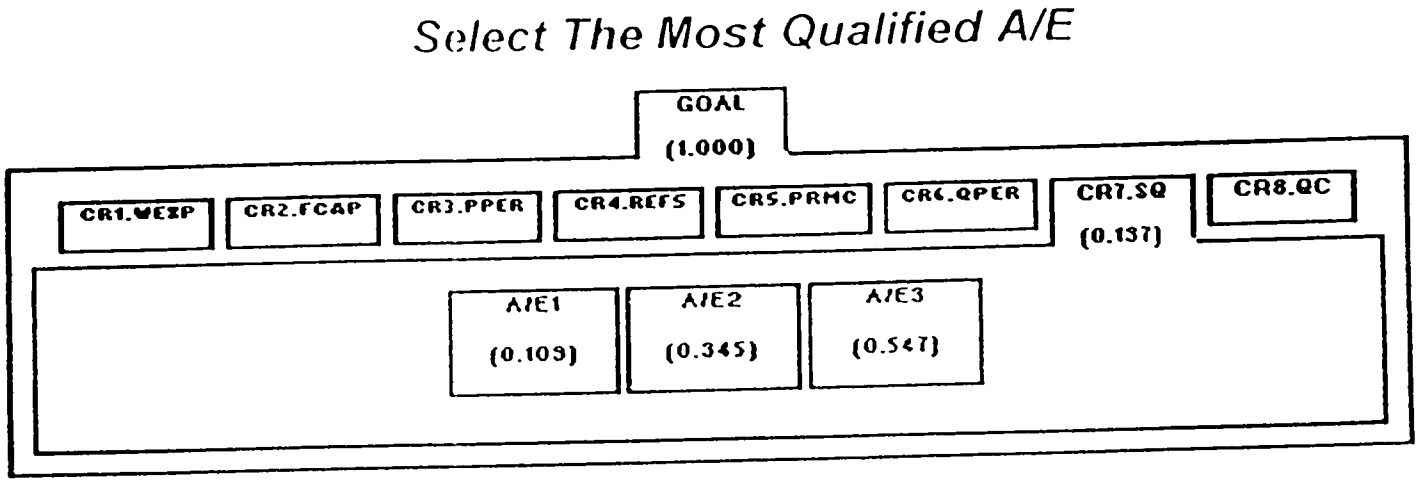



**Figure 7-20** The (CCSM-PSO2) Model Displayed From Staff And Qualification (CR7SQ) Node

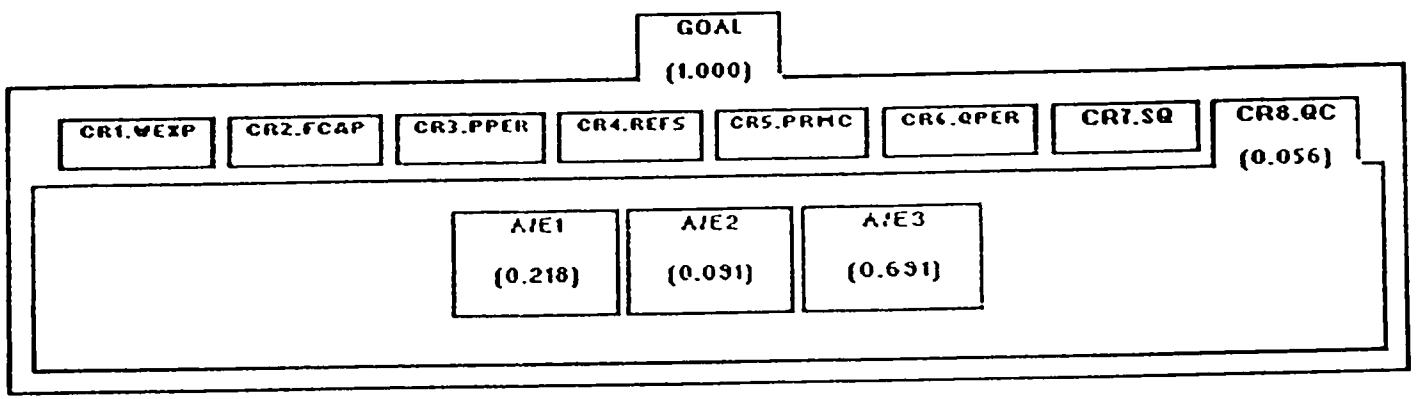
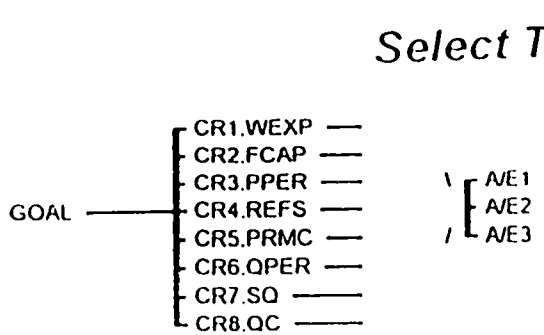



**Figure 7-21** The (CCSM-PSO2) Model Displayed From QUALITY CONTROL (CR8QC) Node




| Abbreviation | Definition |
|---|---|
| GOAL | |
| A/E1 | CONSULTANT NUMBER ONE |
| A/E2 | CONSULTANT NUMBER TWO |
| A/E3 | CONSULTANT NUMBER THREE |
| CR1.WEXP | WORK EXPERIENCE |
| CR2.FCAP | FIRM CAPACITY |
| CR3.PPER | PAST PERFORMANCE |
| CR4.REFS | REFERENCES |
| CR5.PRMC | PROJECT MANAGEMENT CAPABILITY |
| CR6.QPER | QUALITY PERFORMANCE |
| CR7.SQ | STAFF AND QUALIFICATIONS |
| CR8.QC | QUALITY CONTROL |

**Figure 7-22** Side-Way View Of The (CCSM-PSO2) Model.

# CHAPTER EIGHT
# TESTING THE SELECTION MODEL

# 8 CHAPTER- EIGHT-APPLICATION OF THE A/E CONSULTANT CONCEPTUAL SELECTION MODEL

## 8-1 Introduction

Using the judgmental data that were obtained from selected Saudi public sector organizations, the structured CCSM model was implemented. The judgments for criteria and alternatives "which had been obtained" were inserted in the pairwise comparison matrices (Appendix-D). These judgements used the numbers to represent the relative preference or importance of selection criteria over another in the same level with respect to an element in the next level above. This chapter explained the method of the application and discusses the results.

The use of the CCSM model involved two selected public organization involved heavily in A/E selection for public projects and services. The two public sector organizations (PSO1, and PSO2) agreed to use the A/E selection model for conducting the selection of consultants for the needed services. They were asked to fill in their judgments in the pairwise comparison matrix forms II and III (Appendix- D) for selection criteria with respect to goal, and for alternatives with respect to each criterion. Then, the judgements provided were inserted into the Expert Choice program for calculating priorities, testing the consistency of the judgements, and finally conducting an overall synthesis to determine the overall results.

The use of AHP for the application of the A/E selection model included conducting the following steps:

- Pairwise Assessment.
- Calculating Priorities.
- Testing the Consistency.
- Synthesizing for overall results.

## 8-2 Pairwise Assessment

Once the A/E selection model is built, the next step is to evaluate the selection elements "criteria and alternatives" by making pairewise comparisons. The pairewise comparison is the process of comparing the relative preference or importance of the two selection elements with respect to a parent element in the level above. In this study, the comparison process was repeated for all the elements in the selection model. This ultimately led to the derivation of the priorities for each selection alternative under each criterion, and for each criterion under the goal.

### 8-2-1 Type of Comparison

There are three comparison types available in the Expert Choice for the users to choose either one. These comparisons are as follows:

**Importance** is appropriate when comparing one criterion (objective) with another.

**Preference** is appropriate and used when comparing the alternatives.

**Likelihood** is appropriate when comparing probability of outcome. It can be used with either criteria or alternative.

### 8-2-2 Mode of Comparison

There are three comparison modes available in the Expert Choice:

**Verbal** allows for comparing nodes using English language terms.

**Graphical** allows for comparing nodes using graphical measures.

**Numerical** allows for comparing nodes using numbers in a matrix or questionnaire format.

### 8-2-3 Entering Judgments

The process of entering judgements is the main and principal activity of the pairewise assessment for establishing the priorities of the selection elements of the model. For each judgement pair, decision-makers must specify which selection element is more preferable, important, or likely with respect to the parent node. Then the judgements will be reflected depending on the selected comparison mode "either graphically, verbally, or numerically". In this research, the numerical comparison mode was used throughout the pairewise assessment.

However, it was extremely important to familiarize the public sector organizations, which had been selected with the pairwise assessment process, the alternatives and the tradeoff among them. This was done by conducting the pairewise assessment of the model from the bottom of the model upward {35}.

The preference of the selected public sector organizations among the alternatives (A/E1, A/E2, A/E3, A/E4, and A/E5) with respect to each selection criteria was judged. For each comparison matrix, the EC9.5 displayed the alternative priorities, and the related consistency ratio. Figures 8-1, 8-2, 8-3, 8-4, 8-5, 8-6, 8-7, and 8-8 show the comparison matrices, resulted priorities, and consistency ratio based on the judgements provided by the first selected public sector organization (PSO1).

Then, the importance of the main selection criteria with respect to the goal was judged. For each comparison matrix, EC9.5 displayed the selection criteria priorities, and the related consistency ratio. Figure 8-9 shows the comparison matrices, resulted priorities, and consistency ratio based on the judgements provided.

# Select The Most Qualified A/E

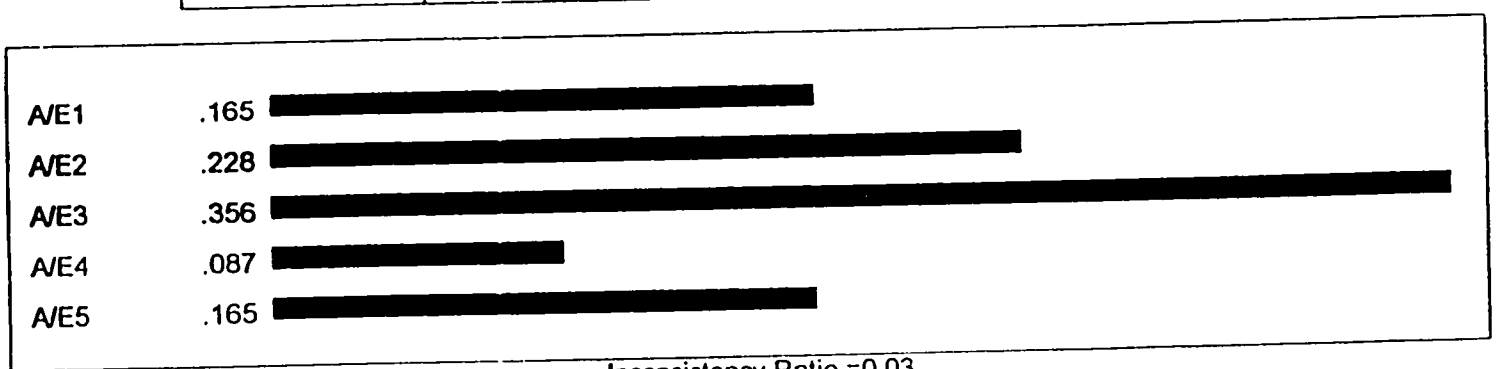
Node: 10000

**Figure 8-1** Compare the relative IMPORTANCE with respect to: CR1.WEXP < GOAL

| | A/E2 | A/E3 | A/E4 | A/E5 |
|---|---|---|---|---|
| A/E1 | 1.0 | (3.0) | 2.0 | 1.0 |
| A/E2 | | 1.0 | 3.0 | 1.0 |
| A/E3 | | | 3.0 | 3.0 |
| A/E4 | | | | (2.0) |

Row element is __ times more than column element unless enclosed in ()

| Abbreviation | Definition |
|---|---|
| Goal | Select The Most Qualified A/E |
| CR1.WEXP | WORK EXPERIENCE |
| A/E1 | CONSULTANT NUMBER ONE |
| A/E2 | CONSULTANT NUMBER TWO |
| A/E3 | CONSULTANT NUMBER THREE |
| A/E4 | CONSULTANT NUMBER FOUR |
| A/E5 | CONSULTANT NUMBER FIVE |




Inconsistency Ratio =0.03

# *Select The Most Qualified A/E*

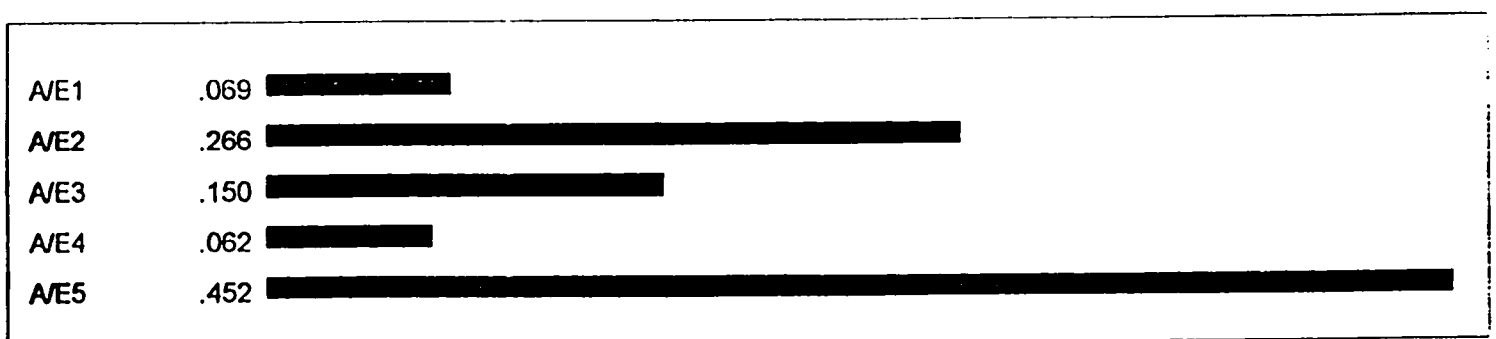
Node: 20000

**Figure 8-2** Compare the relative IMPORTANCE with respect to CR2.FCAP < GOAL

| | A/E2 | A/E3 | A/E4 | A/E5 |
|---|---|---|---|---|
| A/E1 | (3.0) | (3.0) | 1.0 | (5.0) |
| A/E2 | | 3.0 | 5.0 | (3.0) |
| A/E3 | | | 3.0 | (3.0) |
| A/E4 | | | | (5.0) |

Row element is __ times more than column element unless entered in 0

| Abbreviation | Definition |
|---|---|
| Goal | Select The Most Qualified A/E |
| CR2.FCAP | FIRM CAPACITY |
| A/E1 | CONSULTANT NUMBER ONE |
| A/E2 | CONSULTANT NUMBER TWO |
| A/E3 | CONSULTANT NUMBER THREE |
| A/E4 | CONSULTANT NUMBER FOUR |
| A/E5 | CONSULTANT NUMBER FIVE |




Inconsistency Ratio =0.05

# *Select The Most Qualified A/E*

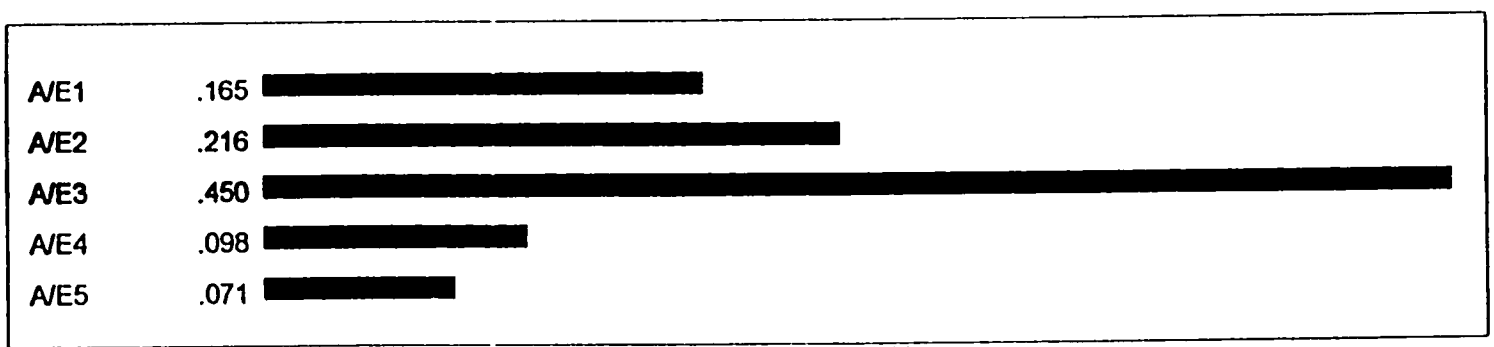
Node: 30000

**Figure 8-3** Compare the relative IMPORTANCE with respect to. CR3.PPER < GOAL

| | A/E2 | A/E3 | A/E4 | A/E5 |
|---|---|---|---|---|
| A/E1 | (3.0) | (3.0) | 3.0 | 3.0 |
| A/E2 | | (3.0) | 1.0 | 3.0 |
| A/E3 | | | 5.0 | 5.0 |
| A/E4 | | | | 1.0 |

Row element is __ times more than column element unless enclosed in ()

| Abbreviation | Definition |
|---|---|
| Goal | Select The Most Qualified A/E |
| CR3.PPER | PAST PERFORMANCE |
| A/E1 | CONSULTANT NUMBER ONE |
| A/E2 | CONSULTANT NUMBER TWO |
| A/E3 | CONSULTANT NUMBER THREE |
| A/E4 | CONSULTANT NUMBER FOUR |
| A/E5 | CONSULTANT NUMBER FIVE |




Inconsistency Ratio =0.09

# Select The Most Qualified A/E

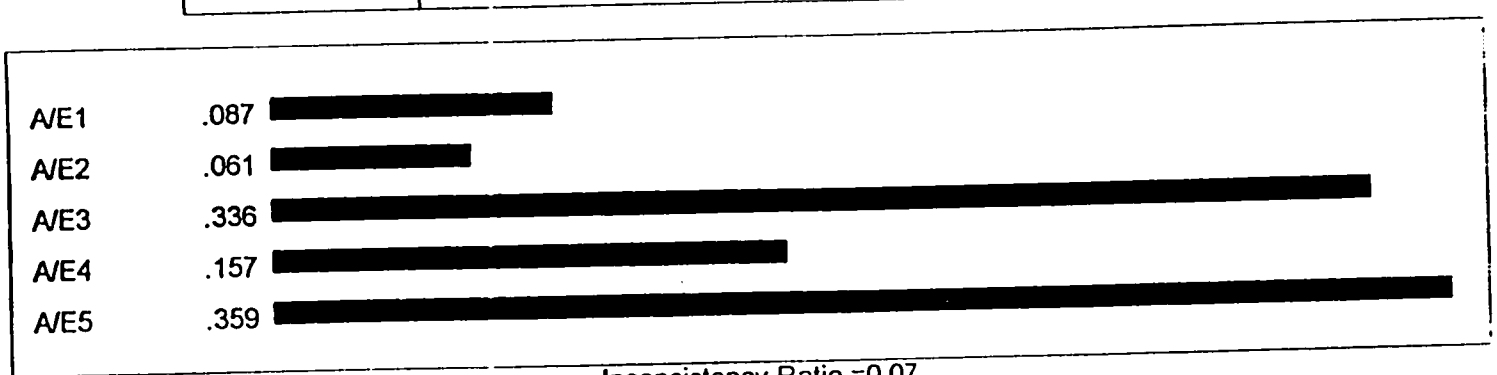
Node: 40000

**Figure 8-4** Compare the relative IMPORTANCE with respect to: CR4.REFS < GOAL

| | A/E2 | A/E3 | A/E4 | A/E5 |
|---|---|---|---|---|
| A/E1 | 3.0 | (5.0) | (3.0) | (5.0) |
| A/E2 | | (3.0) | (3.0) | (5.0) |
| A/E3 | | | 3.0 | 1.0 |
| A/E4 | | | | (3.0) |

Row element is __ times more than column element unless enclosed in ()

| Abbreviation | Definition |
|---|---|
| Goal | Select The Most Qualified A/E |
| CR4.REFS | REFERENCES |
| A/E1 | CONSULTANT NUMBER ONE |
| A/E2 | CONSULTANT NUMBER TWO |
| A/E3 | CONSULTANT NUMBER THREE |
| A/E4 | CONSULTANT NUMBER FOUR |
| A/E5 | CONSULTANT NUMBER FIVE |




Inconsistency Ratio =0.07

# *Select The Most Qualified A/E*

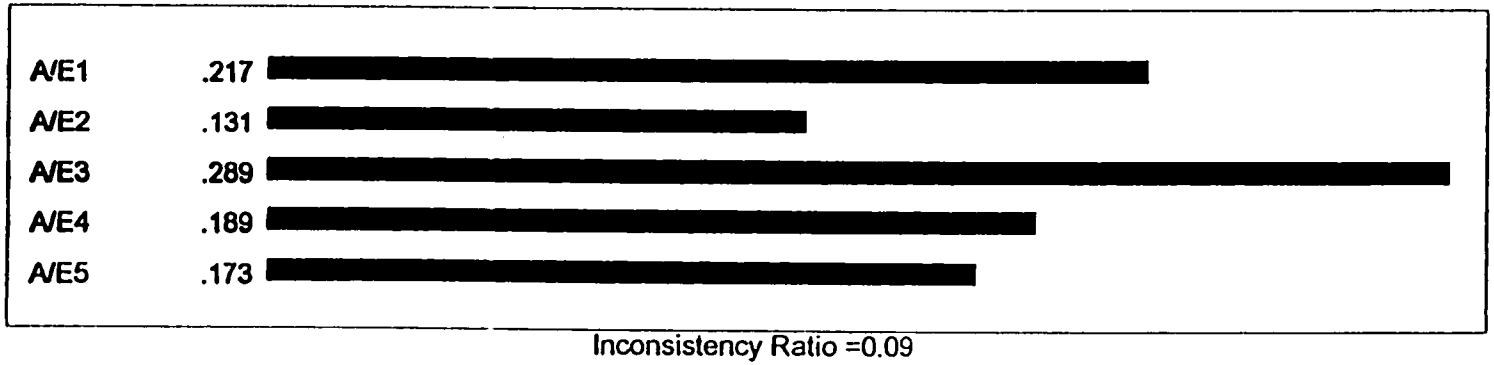
Node: 50000

**Figure 8-5** Compare the relative IMPORTANCE with respect to: CR5.PRMC < GOAL

| | A/E2 | A/E3 | A/E4 | A/E5 |
|---|---|---|---|---|
| A/E1 | 2.0 | (2.0) | 2.0 | 1.0 |
| A/E2 | | 1.0 | (2.0) | (2.0) |
| A/E3 | | | 1.0 | 3.0 |
| A/E4 | | | | 1.0 |

Row element is __ times more than column element unless enclosed in ()

| Abbreviation | Definition |
|---|---|
| Goal | Select The Most Qualified A/E |
| CR5.PRMC | PROJECT MANAGEMENT CAPABILITY |
| A/E1 | CONSULTANT NUMBER ONE |
| A/E2 | CONSULTANT NUMBER TWO |
| A/E3 | CONSULTANT NUMBER THREE |
| A/E4 | CONSULTANT NUMBER FOUR |
| A/E5 | CONSULTANT NUMBER FIVE |




Inconsistency Ratio =0.09

# Select The Most Qualified A/E

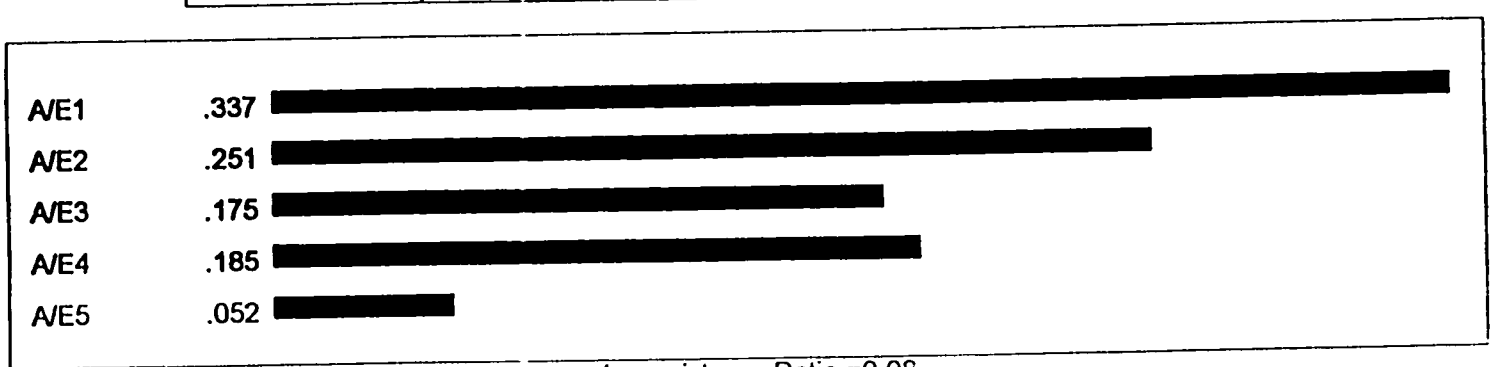
Node: 60000

**Figure 8-6** Compare the relative IMPORTANCE with respect to: CR6.QPER < GOAL

| | A/E2 | A/E3 | A/E4 | A/E5 |
|---|---|---|---|---|
| A/E1 | 2.0 | 3.0 | 1.0 | 5.0 |
| A/E2 | | 2.0 | 2.0 | 4.0 |
| A/E3 | | | 2.0 | 3.0 |
| A/E4 | | | | 5.0 |

Row element is __ times more than column element unless enclosed in ()

| Abbreviation | Definition |
|---|---|
| Goal | Select The Most Qualified A/E |
| CR6.QPER | QUALITY PERFORMANCE |
| A/E1 | CONSULTANT NUMBER ONE |
| A/E2 | CONSULTANT NUMBER TWO |
| A/E3 | CONSULTANT NUMBER THREE |
| A/E4 | CONSULTANT NUMBER FOUR |
| A/E5 | CONSULTANT NUMBER FIVE |




Inconsistency Ratio =0.08

# Select The Most Qualified A/E

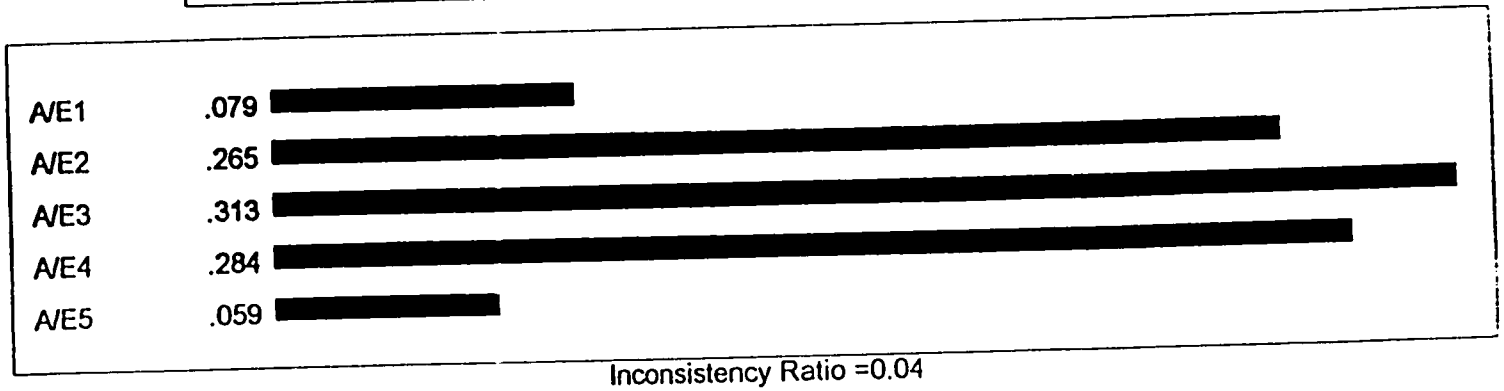
Node: 70000

**Figure 8-7** Compare the relative IMPORTANCE with respect to: CR7.SQ < GOAL

| | A/E2 | A/E3 | A/E4 | A/E5 |
|---|---|---|---|---|
| A/E1 | (4.0) | (4.0) | (4.0) | 2.0 |
| A/E2 | | (2.0) | 1.0 | 6.0 |
| A/E3 | | | 1.0 | 3.0 |
| A/E4 | | | | 5.0 |

Row element is __ times more than column element unless enclosed in ()

| Abbreviation | Definition |
|---|---|
| Goal | Select The Most Qualified A/E |
| CR7.SQ | STAFF AND QUALIFICATIONS |
| A/E1 | CONSULTANT NUMBER ONE |
| A/E2 | CONSULTANT NUMBER TWO |
| A/E3 | CONSULTANT NUMBER THREE |
| A/E4 | CONSULTANT NUMBER FOUR |
| A/E5 | CONSULTANT NUMBER FIVE |




Inconsistency Ratio =0.04

# *Select The Most Qualified A/E*

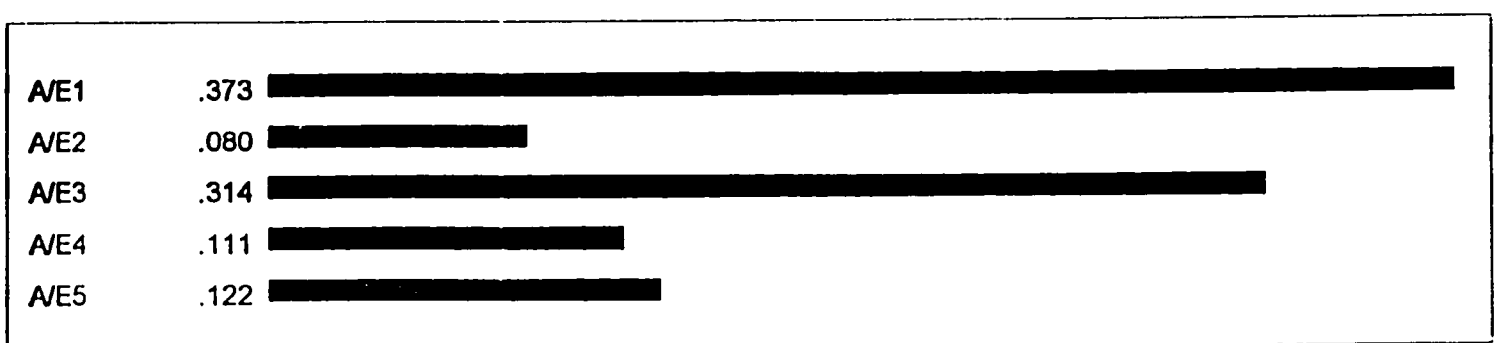
Node: 80000

**Figure 8-8** Compare the relative IMPORTANCE with respect to: CR8.QC < GOAL

| | A/E2 | A/E3 | A/E4 | A/E5 |
|---|---|---|---|---|
| A/E1 | 5.0 | 1.0 | 4.0 | 3.0 |
| A/E2 | | (4.0) | 1.0 | (2.0) |
| A/E3 | | | 2.0 | 3.0 |
| A/E4 | | | | 1.0 |

Row element is __ times more than column element unless enclosed in ()

| Abbreviation | Definition |
|---|---|
| Goal | Select The Most Qualified A/E |
| CR8.QC | QUALITY CONTROL |
| A/E1 | CONSULTANT NUMBER ONE |
| A/E2 | CONSULTANT NUMBER TWO |
| A/E3 | CONSULTANT NUMBER THREE |
| A/E4 | CONSULTANT NUMBER FOUR |
| A/E5 | CONSULTANT NUMBER FIVE |




Inconsistency Ratio =0.02

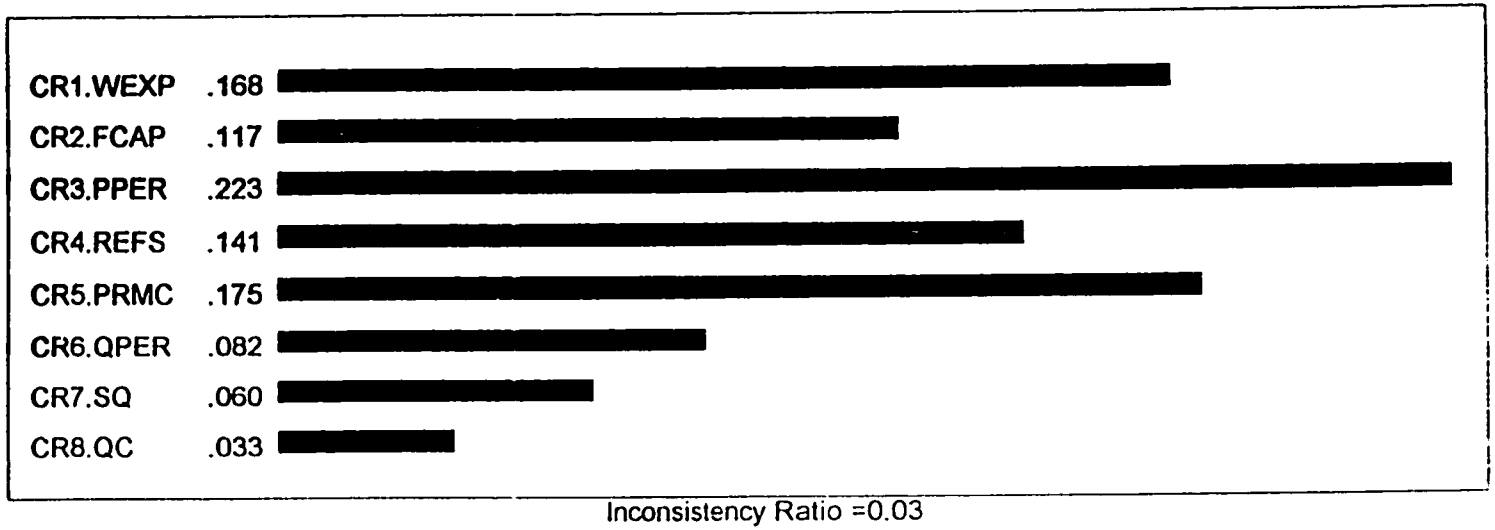
## *Select The Most Qualified A/E*

Node: 0

**Figure 8-9** Compare the relative IMPORTANCE with respect to: GOAL <

| | CR2.FCAP | CR3.PPER | CR4.REFS | CR5.PRMC | CR6.QPER | CR7.SQ | CR8.QC |
|---|---|---|---|---|---|---|---|
| CR1.WEXP | 2.0 | (2.0) | 1.0 | 1.0 | 3.0 | 3.0 | 4.0 |
| CR2.FCAP | | (2.0) | 1.0 | (2.0) | 1.0 | 3.0 | 5.0 |
| CR3.PPER | | | 2.0 | 1.0 | 3.0 | 3.0 | 5.0 |
| CR4.REFS | | | | 1.0 | 2.0 | 2.0 | 5.0 |
| CR5.PRMC | | | | | 3.0 | 2.0 | 4.0 |
| CR6.QPER | | | | | | 2.0 | 3.0 |
| CR7.SQ | | | | | | | 2.0 |

Row element is __ times more than column element unless enclosed in ()




Inconsistency Ratio =0.03

## 8-3 Inconsistency

Generally the inconsistency ratio of 0.10 (10%) is acceptable, and any inconsistency greater than 0.10 calls for the reexamining of the judgements provided. Complete consistency is achieved when the inconsistency ratio is zero. However, total consistency should not be expected, and having an inconsistency ratio of 0.0 is not the objective. Getting results that reflect reality is what is important {35}.

For this research study, the earlier judgements provided resulted in higher inconsistency. The improvement of this inconsistency was accomplished by reexamine judgements provided. The selected organizations with highly inconsistent judgements were contacted, briefed on the inconsistency situation, and informed that the larger the ratio, the more inconsistent the judgements are. Then with their newly corrected judgements, the inconsistency ratio was lowered into the acceptable range (less than 0.10).

## 8-4 Synthesizing

After recording all of preferences and importance, the next step is generating the global weights of the nodes by combining the local priorities throughout the entire model. This is called synthesis. It is the process of converting the local priorities into global priorities of the selection model, and giving the alternatives global weights.

There are two synthesis modes: Ideal and Distributive". The choice of the appropriate synthesis mode depends on whether the application deals with the decision situation as prioritizing all the alternatives based on their relative worth (Distributive Mode) or picking the best alternative (Ideal Mode){35}.

In this research, the distributive mode was used to perform the synthesis from the goal node to get the overall results. The overall priorities of the synthesis and the inconsistency ratio are shown in Figure 8.10. The distributive synthesis ranked the

prospective A/Es with the most qualified consultant at the top. Details of the synthesis are shown in Figure 8.11.

Based on judgements that were provided by the second selected public sector organization two (PSO2), the resulting priorities, consistency ratio, overall synthesis, and details of synthesis are shown in Figures 8-12 to 8-22.

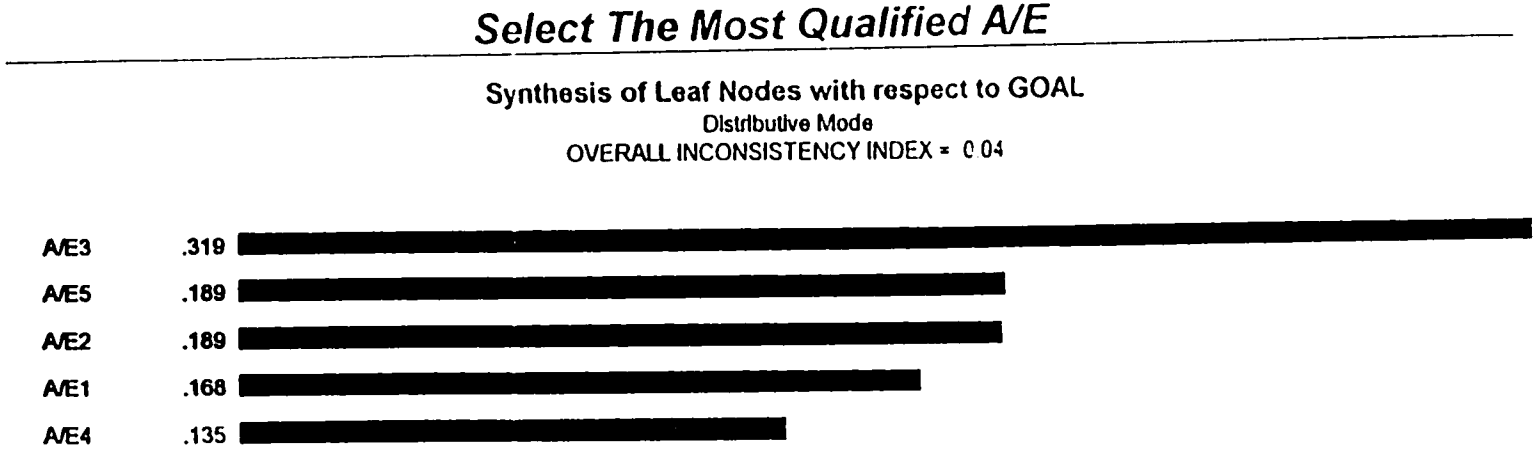



**Figure 8-10** Overall Synthesis Results

**Synthesis of Leaf Nodes with respect to GOAL**

Distributive Mode

OVERALL INCONSISTENCY INDEX = 0.04

| LEVEL 1 | LEVEL 2 | LEVEL 3 | LEVEL 4 | LEVEL 5 |
|---|---|---|---|---|
| CR3.PPER=.223 | | | | |
| | A/E3 =.100 | | | |
| | A/E2 =.048 | | | |
| | A/E1 =.037 | | | |
| | A/E4 =.022 | | | |
| | A/E5 =.016 | | | |
| CR5.PRMC=.175 | | | | |
| | A/E3 =.050 | | | |
| | A/E1 =.038 | | | |
| | A/E4 =.033 | | | |
| | A/E5 =.030 | | | |
| | A/E2 =.023 | | | |
| CR1.WEXP=.168 | | | | |
| | A/E3 =.060 | | | |
| | A/E2 =.038 | | | |
| | A/E1 =.028 | | | |
| | A/E5 =.028 | | | |
| | A/E4 =.015 | | | |
| CR4.REFS=.141 | | | | |
| | A/E5 =.051 | | | |
| | A/E3 =.047 | | | |
| | A/E4 =.022 | | | |
| | A/E1 =.012 | | | |

Figure 8-11 Detail of Synthesis

## Select The Most Qualified A/E

| | | | | |
|---|---|---|---|---|
| | A/E2 =.009 | | | |
| CR2.FCAP=.117 | | | | |
| | A/E5 =.053 | | | |
| | A/E2 =.031 | | | |
| | A/E3 =.018 | | | |
| | A/E1 =.008 | | | |
| | A/E4 =.007 | | | |
| CR6.QPER=.082 | | | | |
| | A/E1 =.028 | | | |
| | A/E2 =.021 | | | |
| | A/E4 =.015 | | | |
| | A/E3 =.014 | | | |
| | A/E5 =.004 | | | |
| CR7.SQ =.060 | | | | |
| | A/E3 =.019 | | | |
| | A/E4 =.017 | | | |
| | A/E2 =.016 | | | |
| | A/E1 =.005 | | | |
| | A/E5 =.004 | | | |
| CR8.QC =.033 | | | | |
| | A/E1 =.012 | | | |
| | A/E3 =.010 | | | |
| | A/E5 =.004 | | | |
| | A/E4 =.004 | | | |
| | A/E2 =.003 | | | |

Figure 8-11 Detail of Synthesis (cont.)

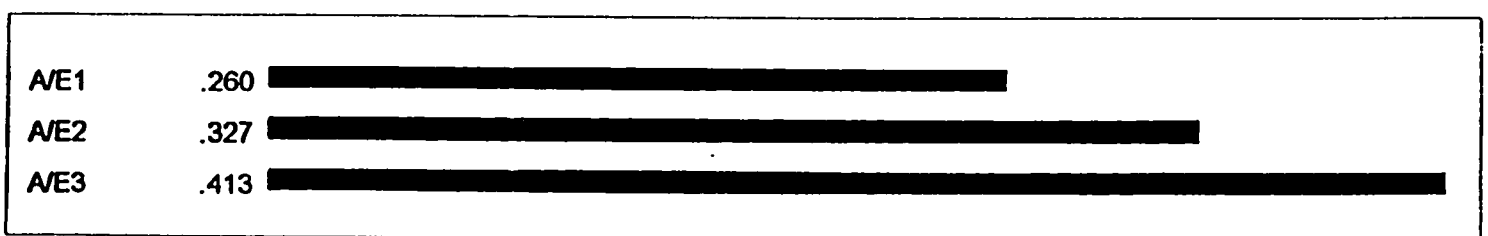
## *Select The Most Qualified A/E*

Node: 10000

Figure 8-12 Compare Relative importance of Alts. With respect to CR1.WEXP< GOAL

| | A/E2 | A/E3 |
|---|---|---|
| A/E1 | 1.0 | (2.0) |
| A/E2 | | 1.0 |

Row element is __ times more than column element unless enclosed in ()




Inconsistency Ratio =0.05

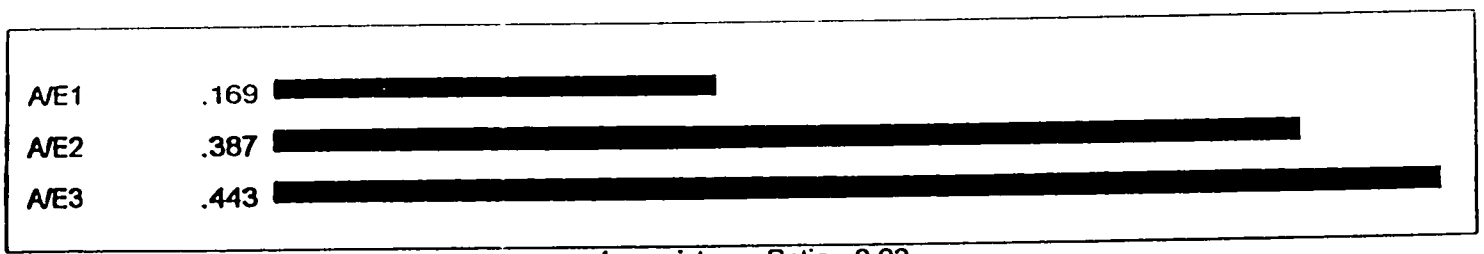
## *Select The Most Qualified A/E*

Node: 20000

**Figure 8-13** Compare the relative IMPORTANCE with respect to: CR2.FCAP < GOAL

| | A/E2 | A/E3 |
|---|---|---|
| A/E1 | (2.0) | (3.0) |
| A/E2 | | 1.0 |

Row element is __ times more than column element unless enclosed in ()




Inconsistency Ratio =0.02

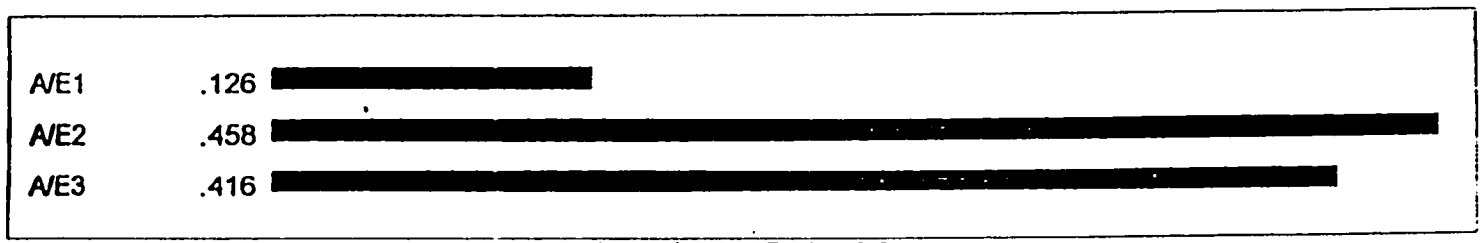
## *Select The Most Qualified A/E*

Node: 30000

**Figure 8-14** Compare the relative IMPORTANCE with respect to: CR3 PPER < GOAL

| | A/E2 | A/E3 |
|---|---|---|
| A/E1 | (4.0) | (3.0) |
| A/E2 | | 1.0 |

Row element is __ times more than column element unless enclosed in ( )




Inconsistency Ratio =0.01

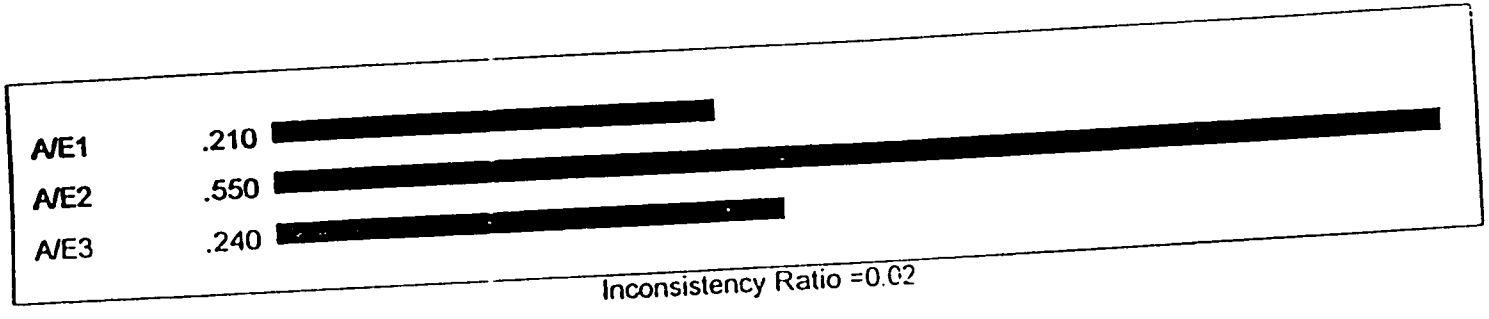
## Select The Most Qualified A/E

Node: 40000

**Figure 8-15** Compare the relative IMPORTANCE with respect to: CR4.REFS < GOAL

| | A/E2 | A/E3 |
|---|---|---|
| A/E1 | (3.0) | 1.0 |
| A/E2 | | 2.0 |

Row element is __ times more than column element unless entered = 0




Inconsistency Ratio =0.02

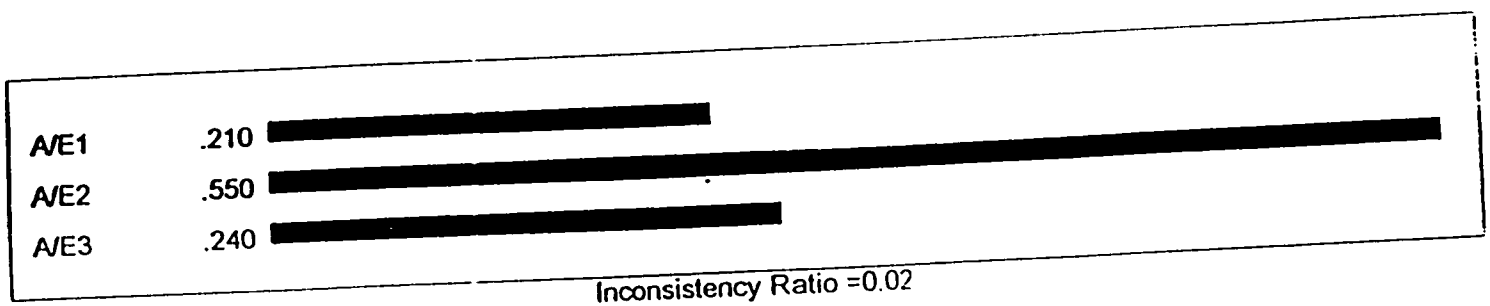
## *Select The Most Qualified A/E*

Node: 50000

**Figure 8-16** Compare the relative IMPORTANCE with respect to: CR5.PRMC < GOAL

| | A/E2 | A/E3 |
|---|---|---|
| A/E1 | (3.0) | 1.0 |
| A/E2 | | 2.0 |

Row element is __ times more than column element unless enclosed in ()

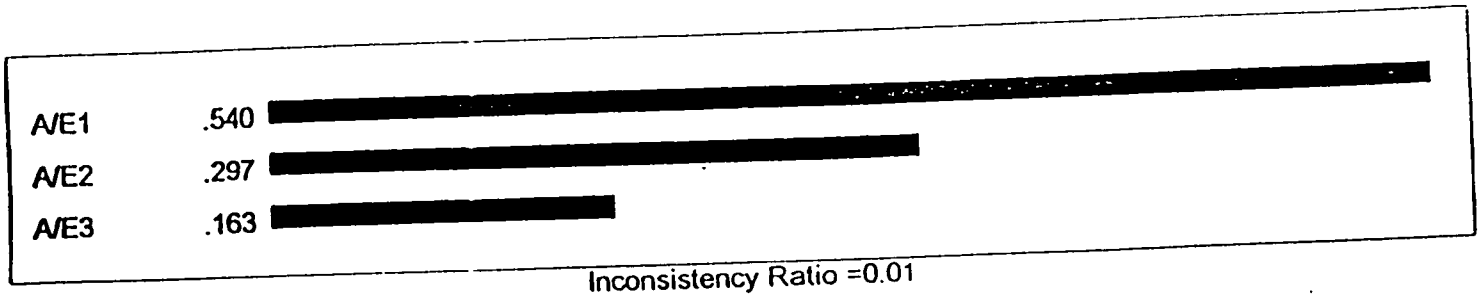


Node: 60000

**Figure 8-17** Compare the relative IMPORTANCE with respect to: CR6.QPER < GOAL

| | A/E2 | A/E3 |
|---|---|---|
| A/E1 | 2.0 | 3.0 |
| A/E2 | | 2.0 |

Row element is __ times more than column element unless enclosed in ()




Inconsistency Ratio =0.01

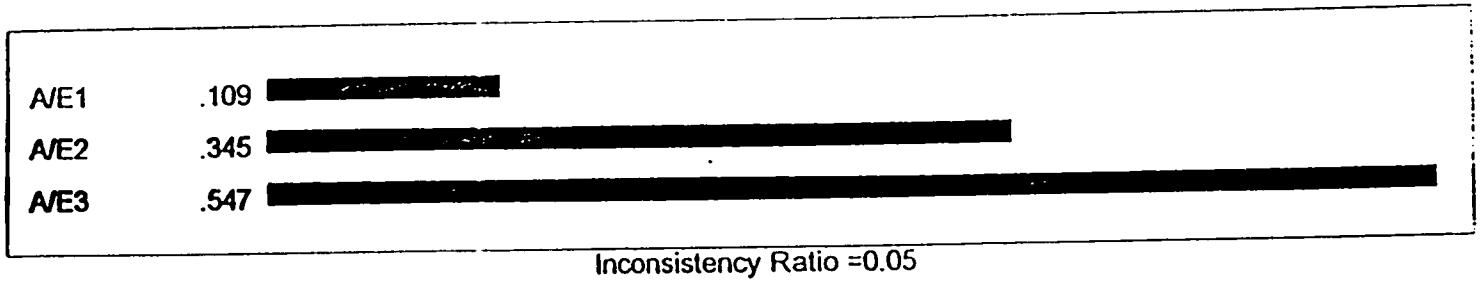
## Select The Most Qualified A/E

Node: 70000

**Figure 8-18** Compare the relative IMPORTANCE with respect to: CR7.SQ < GOAL

| | A/E2 | A/E3 |
|---|---|---|
| A/E1 | (4.0) | (4.0) |
| A/E2 | | (2.0) |

Row element is __ times more than column element unless enclosed in ()




Inconsistency Ratio =0.05

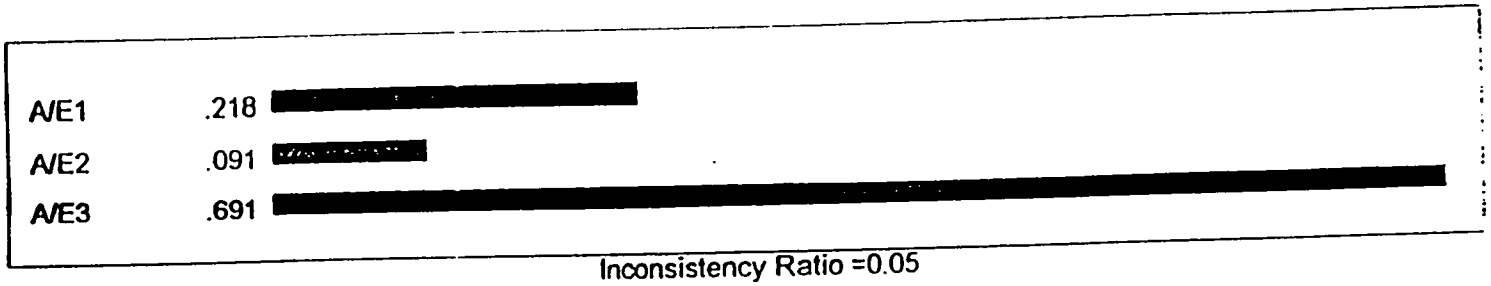
## Select The Most Qualified A/E

Node: 80000

**Figure 8-19** Compare the relative IMPORTANCE with respect to: CR8.QC < GOAL

| | A/E2 | A/E3 |
|---|---|---|
| A/E1 | 3.0 | (4.0) |
| A/E2 | | (6.0) |

Row element is __ times more than column element unless enclosed in ()




Inconsistency Ratio =0.05

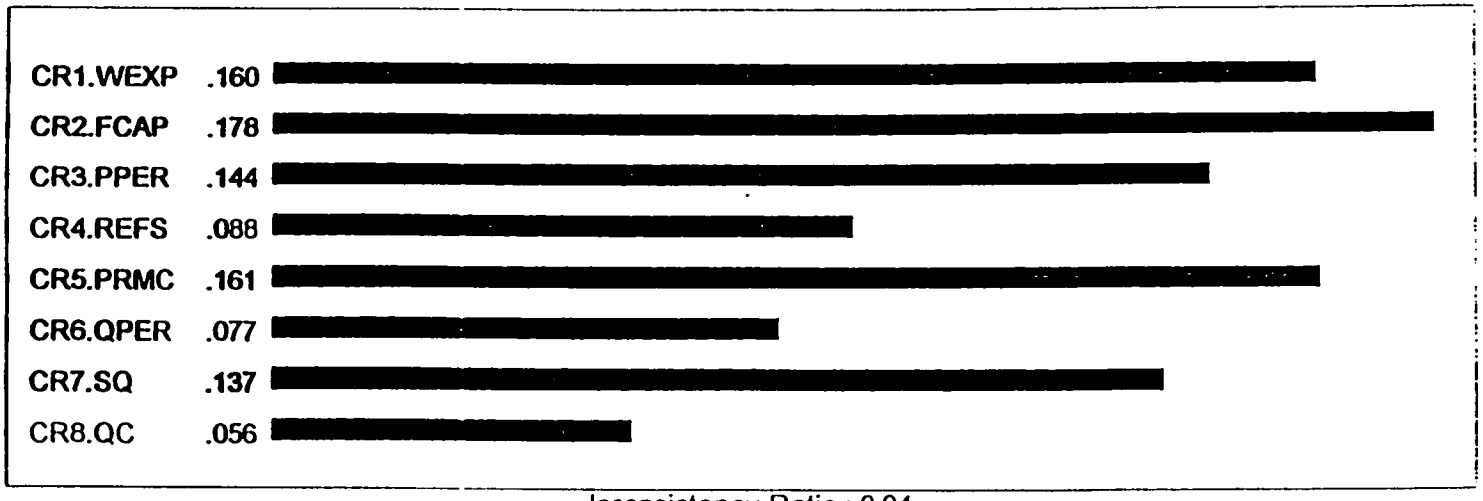
## *Select The Most Qualified A/E*

Node: 0

**Figure 8-20** Compare the relative IMPORTANCE with respect to: GOAL <

| | CR2.FCAP | CR3.PPER | CR4.REFS | CR5.PRMC | CR6.QPER | CR7.SQ | CR8.QC |
|---|---|---|---|---|---|---|---|
| CR1.WEXP | 1.0 | 2.0 | 2.0 | 1.0 | 2.0 | (2.0) | 3.0 |
| CR2.FCAP | | 2.0 | 2.0 | 1.0 | 3.0 | 1.0 | 3.0 |
| CR3.PPER | | | 1.0 | 1.0 | 2.0 | 2.0 | 4.0 |
| CR4.REFS | | | | (2.0) | 1.0 | (2.0) | 2.0 |
| CR5.PRMC | | | | | 2.0 | 2.0 | 2.0 |
| CR6.QPER | | | | | | 1.0 | 1.0 |
| CR7.SQ | | | | | | | 2.0 |

Row element is __ times more than column element unless enclosed in ()




Inconsistency Ratio =0.04

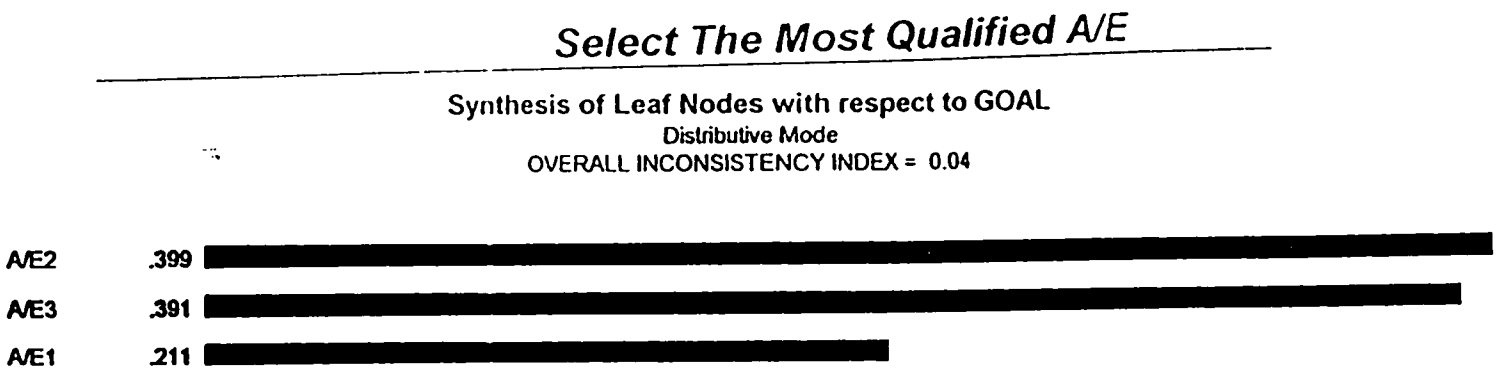



Figure 8-21 Overall Synthesis Results

# Select The Most Qualified A/E

Synthesis of Leaf Nodes with respect to GOAL

Distributive Mode

OVERALL INCONSISTENCY INDEX = 0.04

| LEVEL 1 | LEVEL 2 | LEVEL 3 | LEVEL 4 | LEVEL 5 |
|---|---|---|---|---|
| CR2.FCAP=.178 | | | | |
| | A/E3 =.079 | | | |
| | A/E2 =.069 | | | |
| | A/E1 =.030 | | | |
| CR5.PRMC=.161 | | | | |
| | A/E2 =.088 | | | |
| | A/E3 =.039 | | | |
| | A/E1 =.034 | | | |
| CR1.WEXP=.160 | | | | |
| | A/E3 =.066 | | | |
| | A/E2 =.053 | | | |
| | A/E1 =.042 | | | |
| CR3.PPER=.144 | | | | |
| | A/E2 =.066 | | | |
| | A/E3 =.060 | | | |
| | A/E1 =.018 | | | |
| CR7.SQ =.137 | | | | |
| | A/E3 =.075 | | | |
| | A/E2 =.047 | | | |
| | A/E1 =.015 | | | |
| CR4.REFS=.088 | | | | |
| | A/E2 =.048 | | | |
| | A/E3 =.021 | | | |

Figure 8-22 Detail of Synthesis

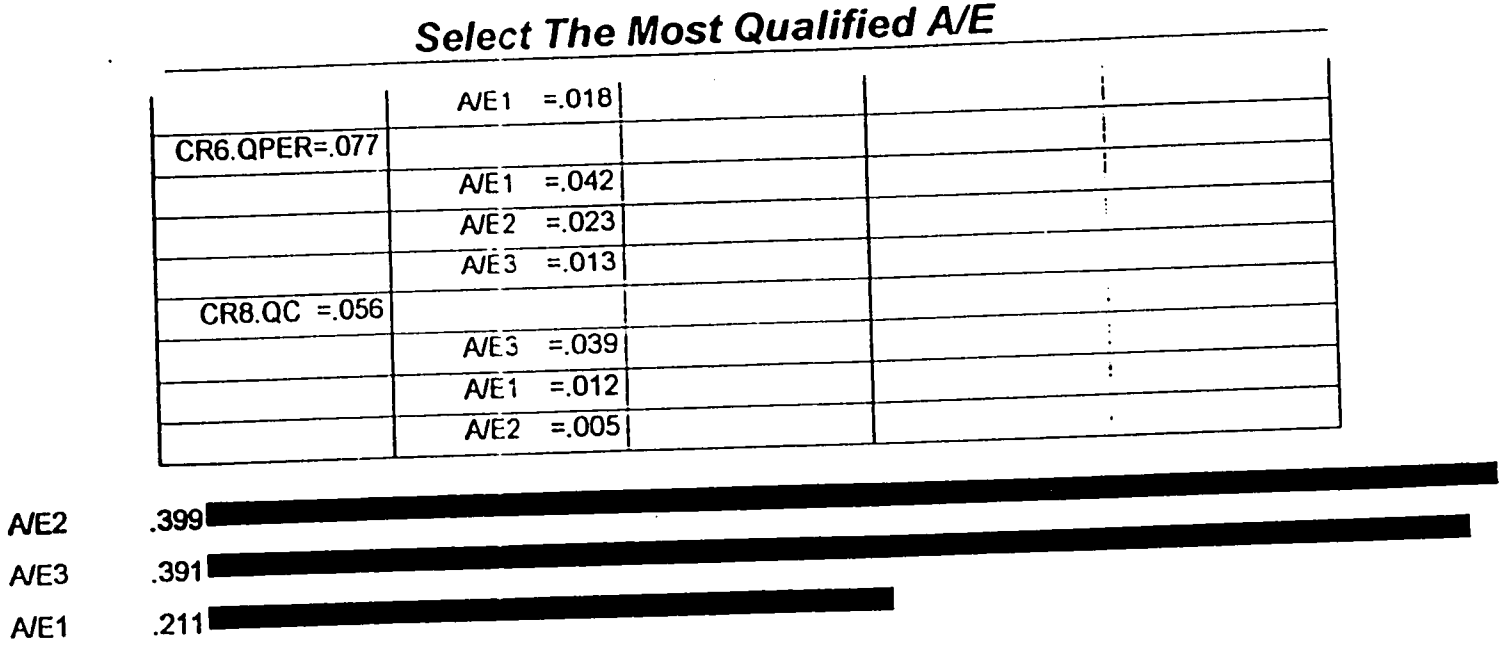



Figure 8-22 Detail of Synthesis (cont.).

## 8-5 Results

The overall results were as follows:

| Public Sector | Synthesis of Overall Prioritizing of Selection Alternatives | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| PSO1 | A/E3 | A/E5 | A/E2 | A/E1 | A/E4 |
| PSO2 | A/E2 | A/E3 | A/E1 | | |

The selected public sector organizations (PSO1, PSO2) accepted the overall result shown in Figures 8-10, and 8-20. However, PSO1 wanted to examine the sensitivity of the alternatives due to changes in the priorities of the CCSM model's main criteria with respect to the goal. The following section explains the sensitivity analysis.

## 8-6 Sensitivity Analysis

The sensitivity analysis is a way of investigating the responsiveness or of testing the sensitivity of the alternatives behavior to changes in the priorities of the main criteria in the model. The Expert Choice software has the ability to deal with such changes and has five ways to display the result of such changes. These ways include Gradient Sensitivity, Two-Dimensional Sensitivity, Performance Sensitivity, Dynamic Sensitivity and Weighted Differences Sensitivity.

For this research, the dynamic sensitivity was used to show the effect on the results due to changes in the priorities of the model's main criteria.

### 8-6-1 Dynamic Sensitivity

The priorities of the model's main criteria were changed one at a time with respect to the goal as follows:

1. The priority of Work Experience (CR1.WEXP) was changed from 0168 to 20.5 (Fig. 8-23). As a result, the priorities of selection alternatives changed as follows:

A/E3 from 0.319 to 0.321
A/E5 from 0.189 to 0.188
A/E2 from 0.189 to 0.190
A/E1 from 0.168 to 0.168
A/E4 from 0.135 to 0.133

2. The priority of Firm Capacity (CR2.FCAP) was changed from 0.117 to 0.680 (Fig. 8-24). As a result, the priorities of selection alternatives changed as follows:

A/E3 from 0.319 to 0.329
A/E5 from 0.189 to 0.175
A/E2 from 0.189 to 0.184
A/E1 from 0.168 to 0.173
A/E4 from 0.135 to 0.139

3. The priority of Past Performance (CR3.PPER) was changed from 0.223 to 0.260 (Fig. 8-25). As a result, the priorities of selection alternatives changed as follows:

A/E3 from 0.319 to 0.325
A/E5 from 0.189 to 0.184
A/E2 from 0.189 to 0.190
A/E1 from 0.168 to 0.168
A/E4 from 0.135 to 0.133

4. The priority of References (CR4.REFS) was changed from 0.141 to 0.205 (Fig. 8-26). As a result, the priorities of selection alternatives changed as follows:

A/E3 from 0.319 to 0.321
A/E5 from 0.189 to 0.202
A/E2 from 0.189 to 0.179
A/E1 from 0.168 to 0.162
A/E4 from 0.135 to 0.136

5. The priority of Project Management capability (CR5.PRMC) was changed from 0.175 to 0.219 (Fig. 8-27). As a result, the priorities of selection alternatives changed as follows:

A/E3 from 0.319 to 0.318
A/E5 from 0.189 to 0.189
A/E2 from 0.189 to 0.186
A/E1 from 0.168 to 0.170
A/E4 from 0.135 to 0.138

6. The priority of Quality Performance (CR6.QPER) was changed from 0.820 to 0.129 (Fig. 8-28). As a result, the priorities of selection alternatives changed as follows:

A/E3 from 0.319 to 0.312
A/E5 from 0.189 to 0.182
A/E2 from 0.189 to 0.192
A/E1 from 0.168 to 0.176
A/E4 from 0.135 to 0.137

7. The priority of Staff and Qualification (CR7.SQ) was changed from 0.600 to 0.150 (Fig. 8-29). As a result, the priorities of selection alternatives changed as follows:

A/E3 from 0.319 to 0.319
A/E5 from 0.189 to 0.177
A/E2 from 0.189 to 0.196
A/E1 from 0.168 to 0.159
A/E4 from 0.135 to 0.149

8. The priority of Quality Control (CR8.QC) was changed from 0.33 to 0.105 (Fig. 8-30). As a result, the priorities of selection alternatives changed as follows:

A/E3 from 0.319 to 0.319
A/E5 from 0.189 to 0.184
A/E2 from 0.189 to 0.181
A/E1 from 0.168 to 0.183
A/E4 from 0.135 to 0.133

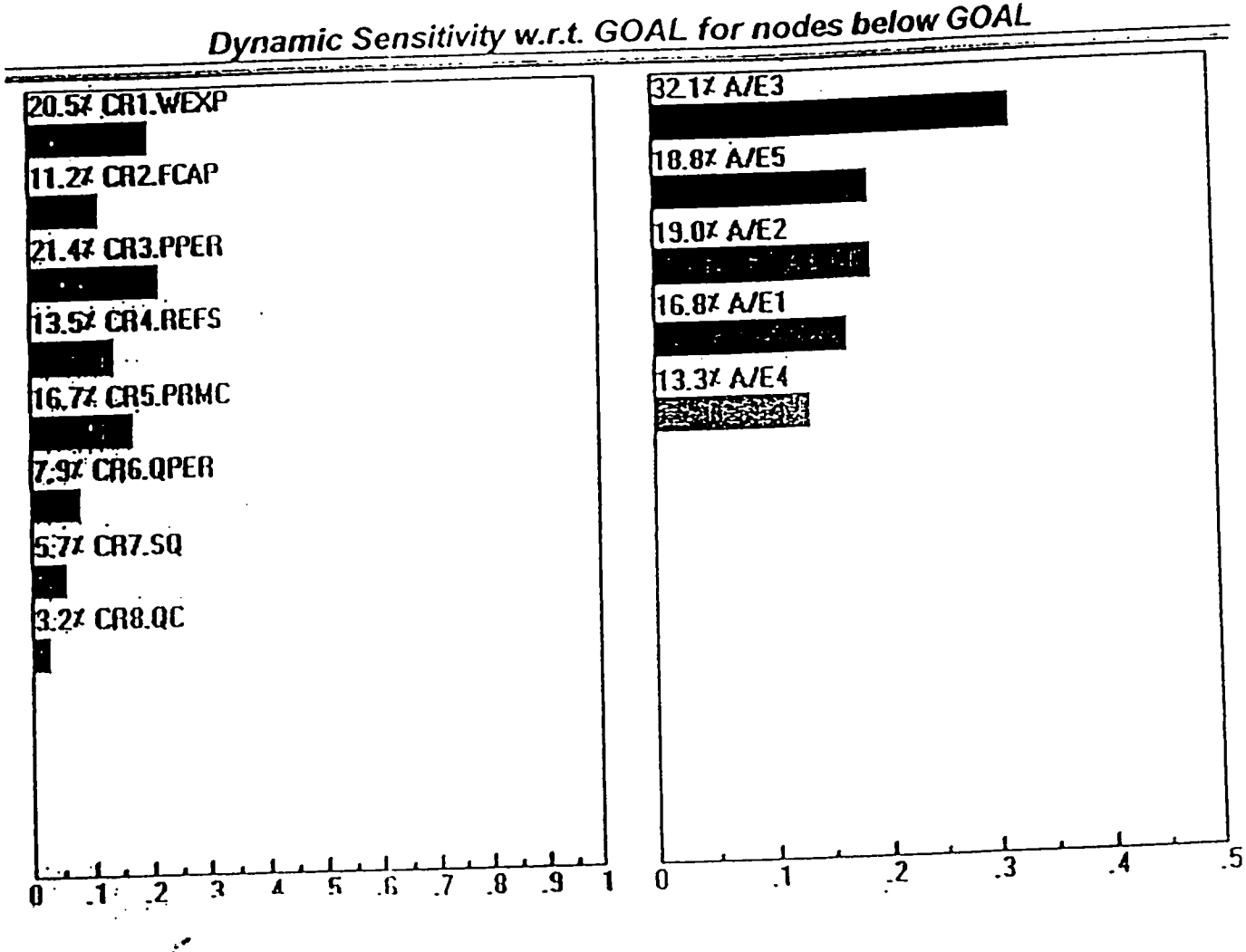



Figure 8.23 Change in Alternatives' Priorities Due to Change in work Experience

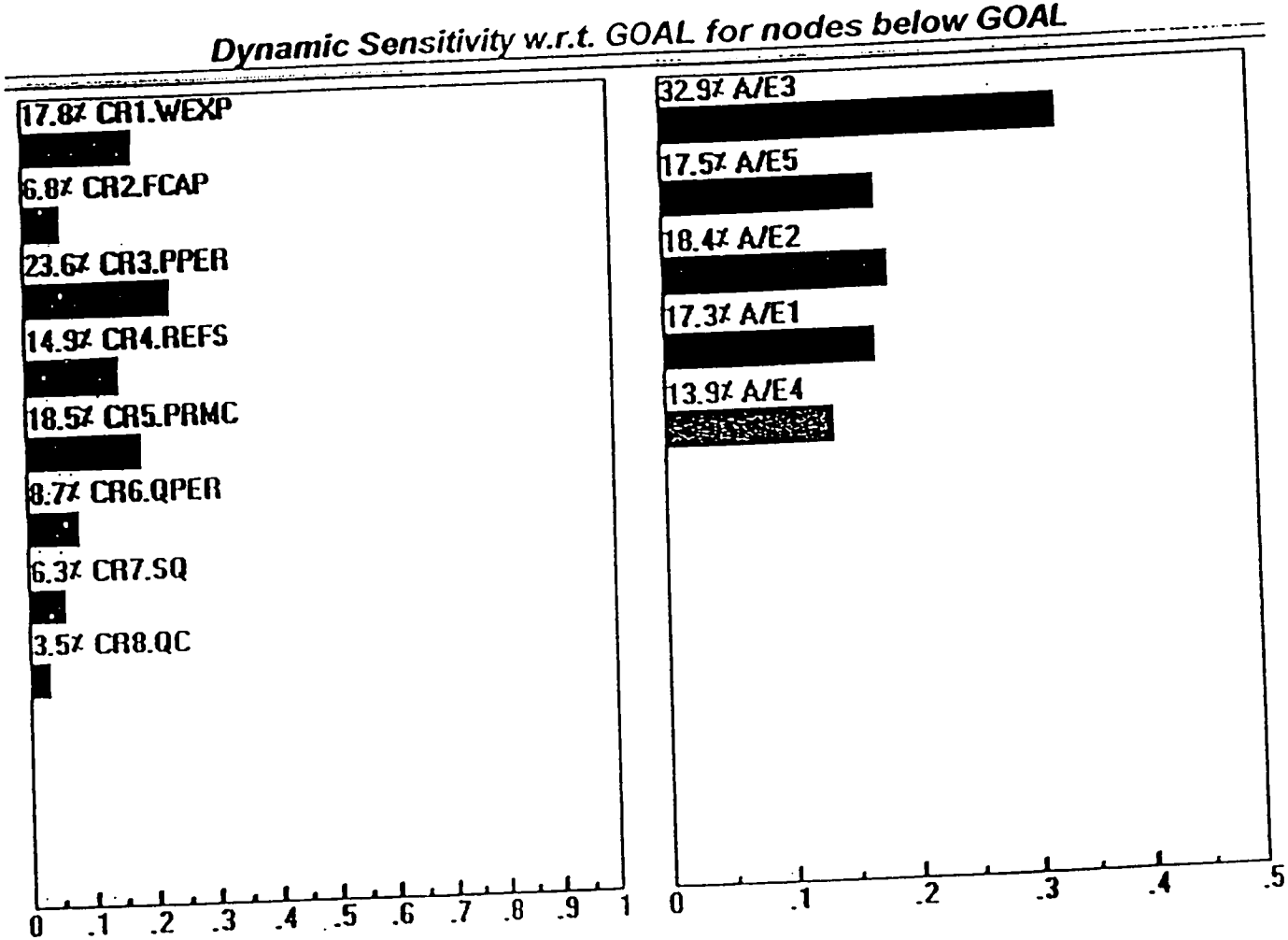



**Figure 8.24** Change in Alternatives' Priorities Due to Change in Firm Capacity.

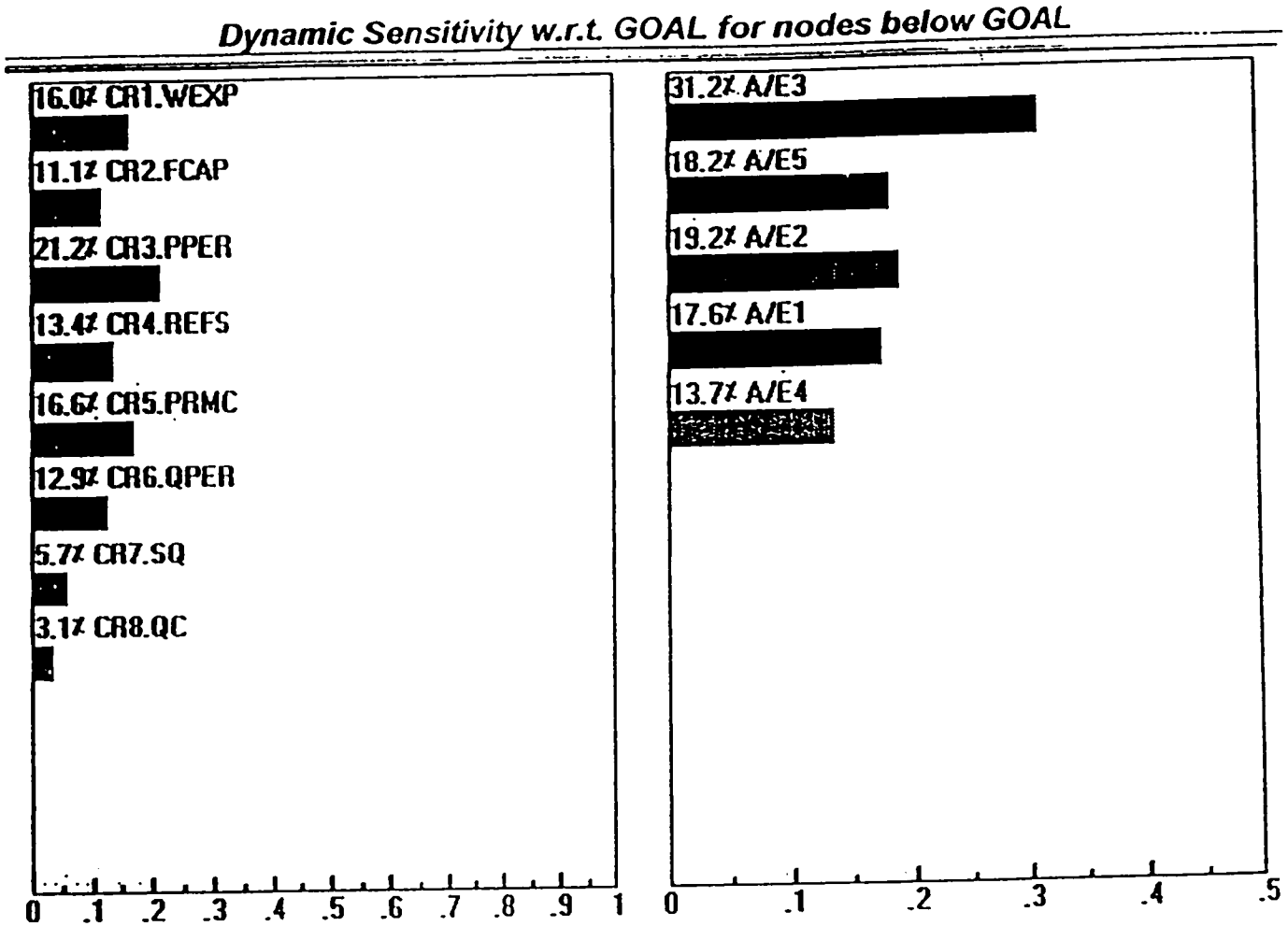



Figure 8.25 Change in Alternatives' Priorities Due to Change in Past Performance.

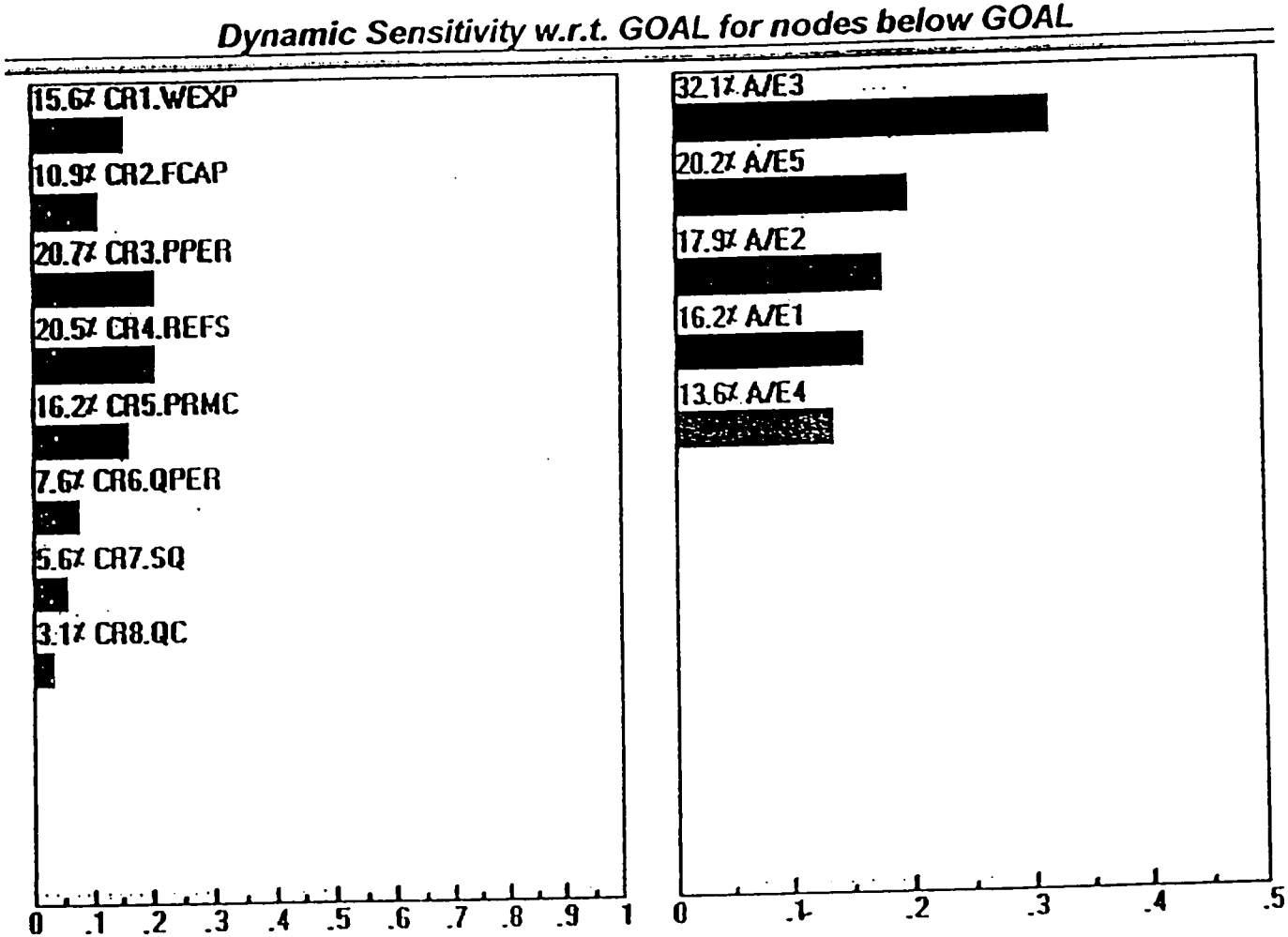



Figure 8.26 Change in Alternatives' Priorities Due to Change in References.

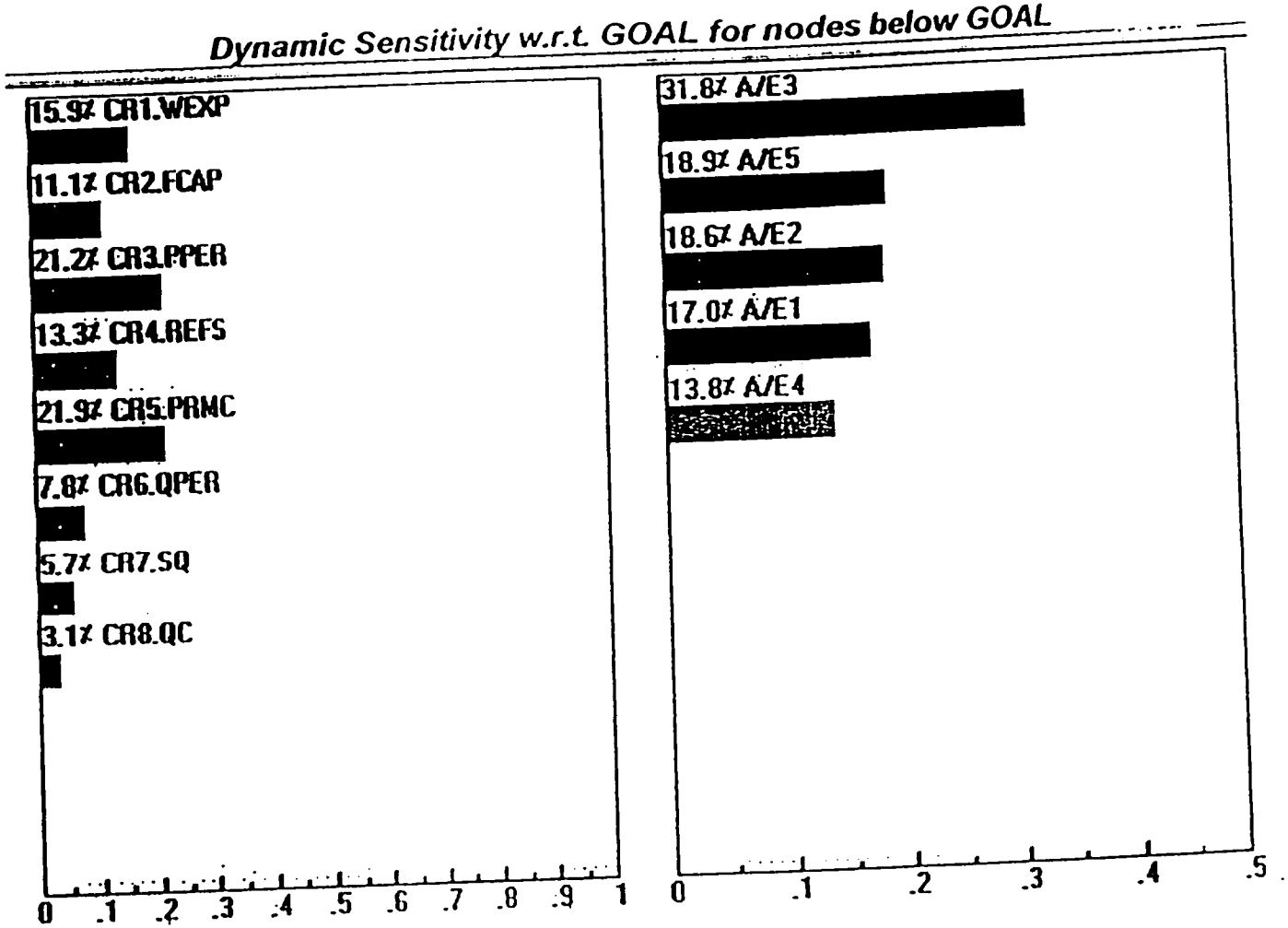



**Figure 8.27** Change in Alternatives' Priorities Due to Change in Project Management Capability

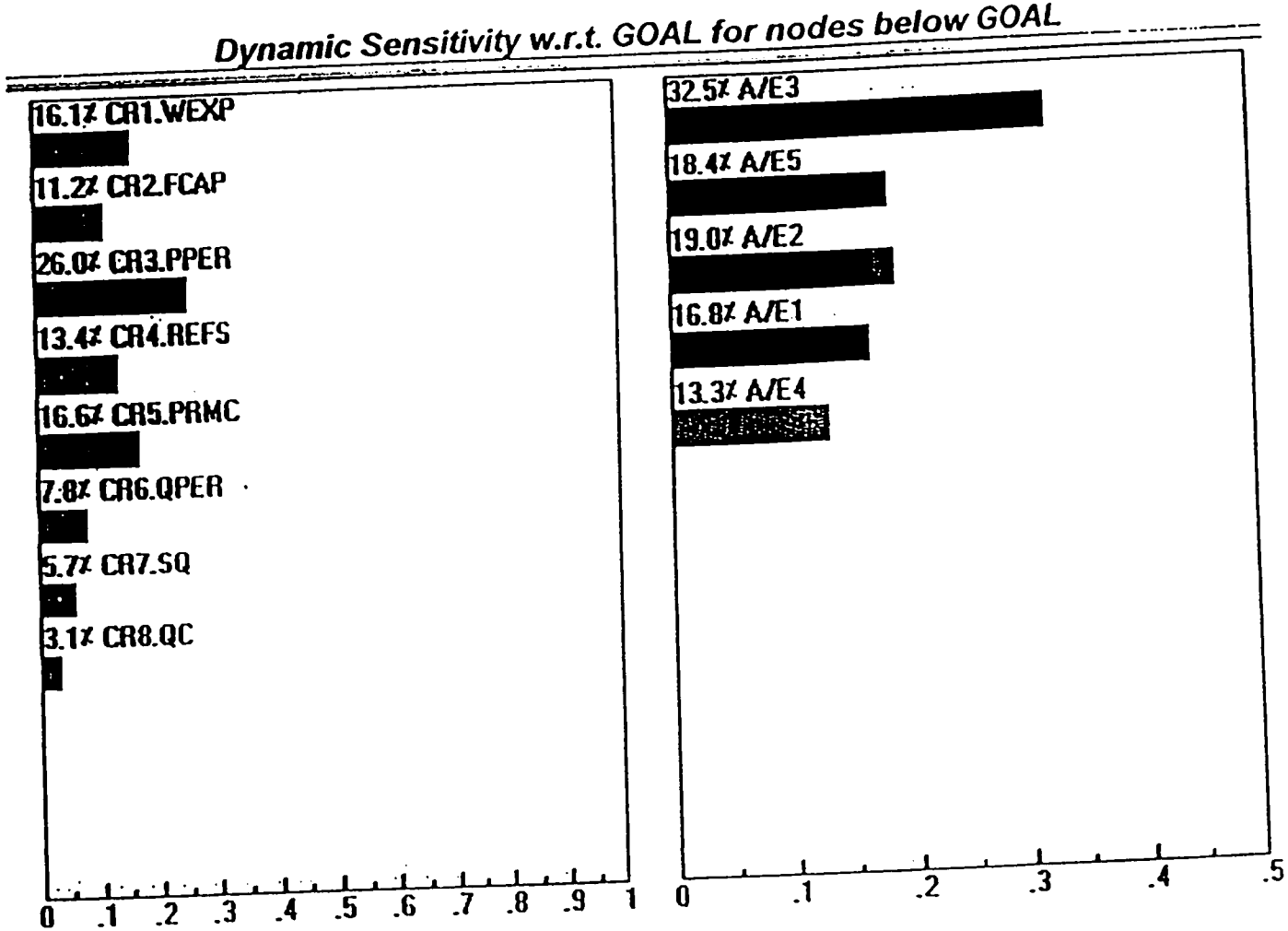



**Figure 8.28** Change in Alternatives' Priorities Due to Change in Quality Performance.

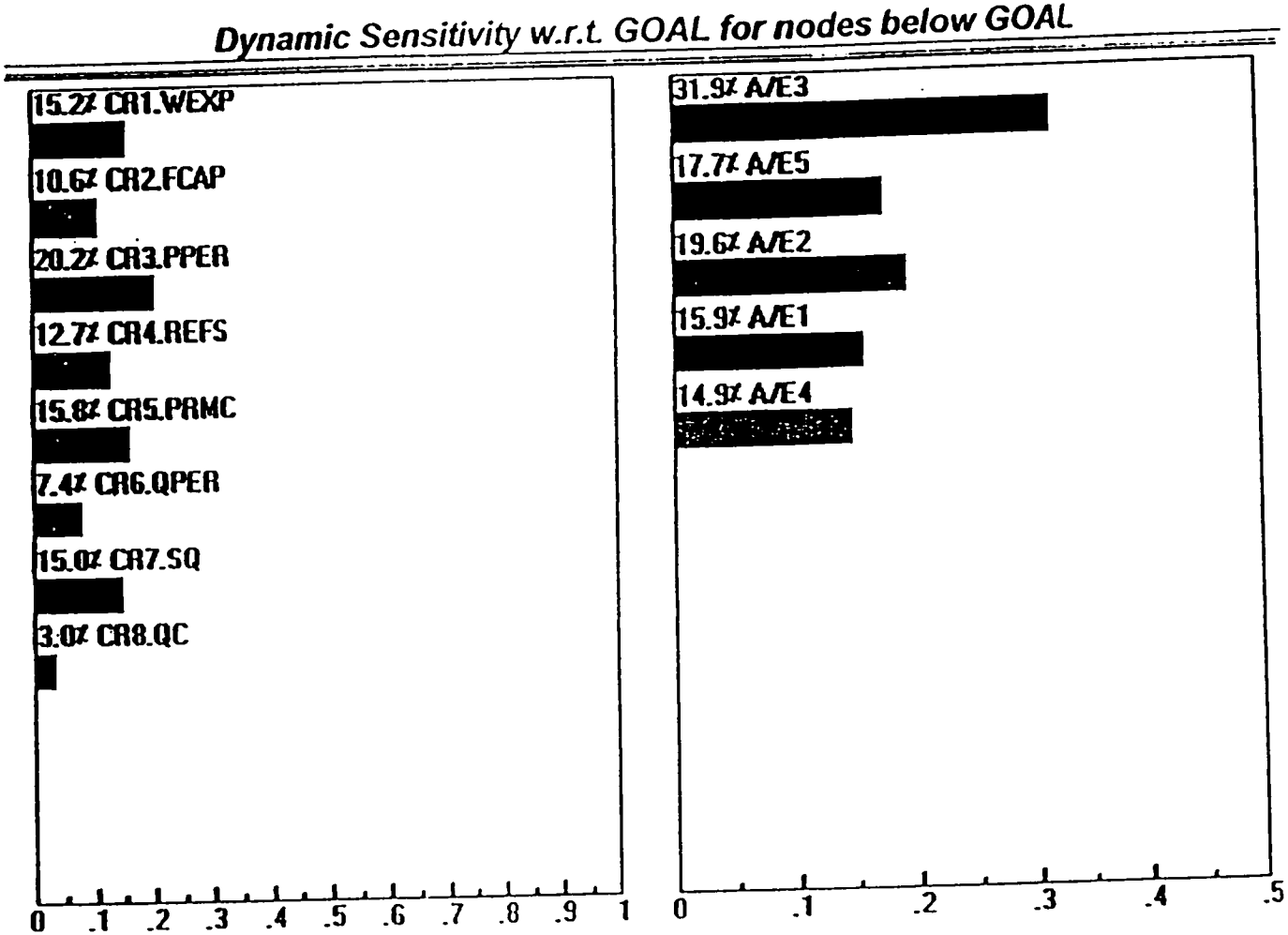



**Figure 8.29** Change in Alternatives' Priorities Due to Change in Staff and Qualification

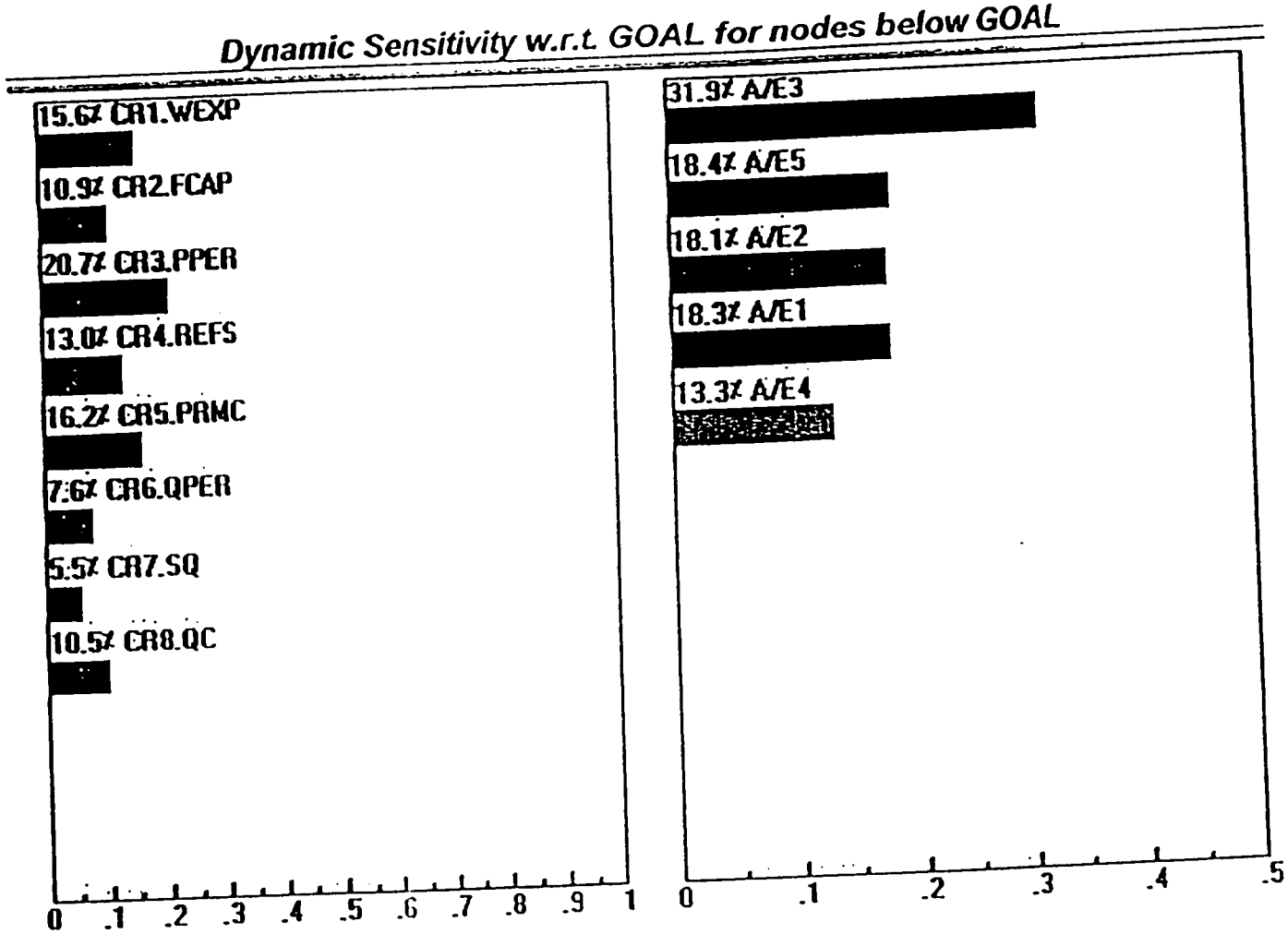



**Figure 8.30** Change in Alternatives' Priorities Due to Change in Quality Control.

# CHAPTER NINE
# THE CONCLUSION

# 9 CHAPTER NINE – CONCLUSION AND RECOMMENDATIONS

## 9-1 Introduction

Because of the many factors contributing to the difficulties of selecting a qualified A/E, selection methods differ from one public sector to another. They are distinguished by insufficiently identified selection criteria, incomprehensive criteria, inflexible criteria and limited usage. Therefore a consistent and well-defined A/E selection method is badly needed to help the Saudi public sector bodies to deal with this important step. Such a consistent approach will enable the public sector organizations to select qualified A/Es. This means engaging an A/E "who will provide an economic, an effective and an efficient professional service for reasonable fee" based on qualifications, ability and full consideration of the specific criteria of a project.

## 9-2 Results Compare to Research's Main Objectives

The main research objective was the improvement of the A/E selection method in Saudi Arabia by identification of the major selection criteria, and by the development of a conceptual consultant selection model CCSM to help the public sector towards successful A/E selection contributing to the success of the public projects.

The first objective of the research "*identifying major selection criteria*" was accomplished as a results of the analysis of data that were gathered through the review of literature, interviews conducted with public sector engineering and construction representatives, and examination of the current selection practices among public sector organizations in Saudia Arabia. Thirteen criteria were identified as the major and most

effective selection criteria. These criteria were ranked by the public sector (Table 6-6). However, due to the inapplicability or similarity of some criteria, most highly recommended criteria of the research are only limited to eight criteria (Figure 7-1 and Table 7-3).

The second objective the research was accomplished by the utilization of the most recommended criteria, and the AHP basic concept to develop an A/E consultant conceptual selection model (CCSM) (Figure 7-2). The careful implementations of this model will systematically guide the public sector to the successful selection of A/E and contribute to the success and quality of projects.

The findings of this research were based on the analysis of data obtained from literature, interviews of public sector organizations and consultants, and examination of current selection practices. Out of 60 questionnaires distributed out, 49 were completed and returned. This represents 82% of the total.

## 9-3 Major Findings

As a result of the interviews conducted and the data about the A/E prequalification and selection process in Saudi Arabia were analyzed, the following findings were noted:

1. The current- A/E prequalification and selection methods are inconsistent, insufficiently adequate for identifying proper selection criteria for proper crucial evaluation and selection. The methods fail to define accurately the goal of A/E selection, and consultant competence to ensure that selected A/E is sufficiently capable and qualified to achieve the needed services.

2. In Saudi Arabia, the major selection criteria were identified and ranked by the public sector as follows:

    - **Staff and Qualifications.**

- **Experience.**
- **Quality Performance.**
- **Project Management Capability.**
- **Past Performance**
- **Quality Control**
- **References**
- **Current Work Load**
- **Firm Organization**
- **Firm Capacity**
- **Economical Constraints**
- **Experience in Geographical Area**
- **Head Office Location**

3. The data analysis indicated a strong agreement between the public sector and consultants in ranking the major selection criteria. The agreement was proved by the high coefficient of rank correlation ($r_s = 0.8242$), and supported by the hypothesis test that indicated that correlation ($r_s = 0.8242$) is larger than the critical value $t_{0.05} = 0.5549$. This means that the rank correlation coefficient ($r_s$) lies in the rejected region, concluding that there is strong rank correlation between the public sector rank and the consultants' rank.

However, the indicated small difference in ranking of the criteria is due to the different levels of experience of the respondents.

4. The staff and qualifications criteria are ranked first. This is due to the fact that public sector considers "Staff and Qualifications Criteria" is the most

important criteria that must be evaluated for proper and successful selection, and for any positive indication that might be realized for the A/E.

5. The public sector ranked "References" seventh among the thirteen selection criteria. They believe that the consultants' references data are not fully updated, and outdated information is usually included.

6. The Saudi public sector organizations extremely believe that Economic Constraints, Experience in Geographical Area and Head Office Location is not applicable criteria in the A/E selection process.

7. The similarities between some criteria called for the combination of those related criteria. As a result, the recommended criteria of the research are (Table 7-3):

- Work Experience
- Project Management Capability
- Staff and Qualification
- Quality Performance
- Past Performance
- Quality Control
- References
- and Firm Capacity

8. The Work Experience and Project Management Capability criteria weigh 40% of the total weight of the selection criteria. This is due to the fact that they are major factors that play a major role in the improvement of consultancy

practice and the success of any project and can not be overlooked by the A/E selection committee.

## 9-4 Conclusion

The main objectives of the research *"Identifying the Major Selection Criteria"* and *"the Development of an A/E Consultant Conceptual Selection Model CCSM"*, were accomplished. The CCSM model was implemented for solving the complicated selection problem, in a practical way by comparing prospective A/Es in terms of selection criteria. The CCSM's concept is concerned with the selecting a capable and competent A/E based on qualification and previous work experience to accomplish special professional service within a given time frame and with the required quality. The implementation proved that the CCSM model is a consistent, practical, and effective selection tool for selecting a qualified A/E. The CCSM is flexible enough to meet the public sector demand for accommodating additional criteria as needed.

## 9-5 Recommendations

Based on the results of the usage of the A/E selection model (CCSM), Saudi public sector organizations are recommended to use the CCSM model for the following reasons:

- The model can represent a standard method "unified framework" that can maximize the usage and the experience among the public sector organizations.
- The model ensures fast but accurate evaluation and successful A/E selection.

- The flexibility of the model enables the user to modify it as required and while retaining a firm grip on the quality of the selection.
- It can be used in the evaluation and selection of the best technical proposals for professional services.
- It can handle single as well as group judgements, making it easy to consider the judgements' of different levels of management.

## 9-6 Recommended Future Studies

- The A/E selection criteria identified and used in this research are the major criteria influencing the selection process, therefore it is recommended that a further study of the secondary or sub-criteria be conducted to determine their effect and contribution to the selection process.

- To ensure the quality of practicing consultancy in Saudi Arabia, it is recommended to A/E be studied further and then finely established.

- The agreement **"CONTRACT"** between owner and A/E should be reviewed to develop a standard agreement that will take in full consideration contract conditions, fees, and level of work experience.

- The classification of A/E should be established and enforced to keep up the quality of consultancy and keep the owner informed of true qualifications and the ability of the A/E when considering the engagement of an A/E.

- A similar selection model for the private sector should be Developed and validated.

# APPENDICES

# 10 APPENDICES

| | |
|---|---|
| **Appendix- A** | Article 3/t (Bid and Tender Policy)<br>Ministry of Finance's Directives. |
| **Appendix- B** | Ministry of Commerce' Requirements For Practicing Engineering in Saudi Arabia |
| **Appendix- C** | Sample of public owners' current prequalification and selection practice |
| **Appendix- D** | The Questionnaire Forms (I, II, III) |
| **Appendix- E** | Value for Spearman Rank Correlation ($r_s$). |
| **Appendix- F** | List of Selected Public Agencies (Government ministries) and Consultants (A/Es). |

# APPENDIX -A-

م/٣/ط -

الأعمال الاستشارية والدراسات ووضع المواصفات والاشراف على تنفيذها بالطريق المباشر في حدود مليون ريال، فاذا زادت القيمة على ذلك فتتم عن طريق دعوة ثلاثة مكاتب استشارية على الأقل ليقدم كل منهم عرضا في خلال فترة تحددها الجهة الادارية يختار الوزير المختص أفضلها ويجب أن يكون الاتفاق على أعمال الدراسات والتصميم بمبالغ مقطوعة، أما أعمال الاشراف على التنفيذ فيجوز أن تكون بمبالغ مقطوعة

*" Consulting services and other services such as studies, drawing up of specifications and supervision of implementation thereof shall be secured through direct purchase if the value thereof does not exceed one million Saudi riyals. If the value exceeds one million riyals, such services shall be secured through the invitation of at least three consulting firms to submit their proposals within a period to be determined by the soliciting agency. The minister concerned shall select the best proposal. Study and design services shall be compensated on a lump sum basis. Supervision services may be compensated on a lump sum or periodic basis or as a percentage of the value of the work to be performed".*

بسم الله الرحمن الرحيم

المملكة العربية السعودية
وزارة المالية والاقتصاد الوطني
الادارة القانونية

الرقم: ٥٩٩/١٧
التاريخ: ١٤٠٤/٢/٣٠هـ
الموضوع: .....

تعميم لجميع الوزارات والمصالح
والمؤسسات الحكومية

سبق أن صدر الامر السامي رقم ٤٧٥١ في ١٤٠٣/٤/٢٦ الذي أبلغ لجميع الاجهزة الحكومية وتم تطبيقه بالعمل والمتضمن في فقرته الاولى (الحاجة الماسة لاكثر عدد من المقاولين المؤهلين للتنافس على مشاريع الحكومة وأعمالها وعدم قصر التعاقد على عدد محدود من الشركات والمؤسسات بل لابد من طرح جميع المشاريع في منافسة عامة يعلن عنها بالصحف ويعطى المتقدمون لها الوقت الكافي).

وقد تلقت الوزارة عدة استفسارات من جهات حكومية حول مدى شمول الفقرة المشار اليها للتعاقد مع المكاتب الاستشارية الهندسية على وضع التصاميم والمواصفات والاشراف على التنفيذ لبعض المشاريع، وقامت بالعرض عن ذلك للمقام السامي بخطابها رقم ٤٠٣/٦٧٠٨ وتاريخ ١٤٠٣/١٢/١٨ موضحة أن اقرار مبدأ المنافسة العامة لهذه الاعمال قد يؤدي الى قيام مكاتب استشارية اجنبية بتقديم عروضها عن طريق شركات أو أفراد مما ينعكس على المشاريع المراد تنفيذها ويعرض الجهة الادارية للمشاكل مع المقاول المنفذ، كما أن الامر السامي المشار اليه يركز على المشاريع الحكومية التنفيذية التي لها مجال واسع وحجم كبير في عقود الدولة وليس فيه مايوحي بأن الترتيبات التي تضمنها تشمل الاعمال الاستشارية. وأن المادة (٣/ط) من نظام تأمين مشتريات الحكومة وتنفيذ مشروعاتها وأعمالها قد تضمنت تنظيما خاصا لهذه الاعمال.

وقد اقترحت الوزارة في خطابها المشار اليه موافقة المقام السامي على أن تقوم بابلاغ الوزارات والمصالح الحكومية بأن التعاقد مع المكاتب الاستشارية يتم طبقا للقواعد النظامية واستثناء تلك الاعمال من طرحها في منافسة عامة يعلن عنها بالصحف والاكتفاء بطرحها في منافسة محدودة.

وحيث أنه قد صدر الامر السامي رقم ٣/١٦٧/م في ١٤٠٤/١/٢٧ متضمنا الموافقة على ماقترحته، نأمل الاحاطة وملاحظة أن يطبق في شأن التعاقد على الاعمال الاستشارية القاعدة التي تضمنتها المادة (٣/ط) من نظام تأمين مشتريات الحكومة دون حاجة لطرحها في منافسة عامة.

وتزى الوزارة أن يكون تنفيذ ذلك ابتداء من الان بالنسبة لما لم يعلن عنه بعد في منافصة عامة من أعمال استشارية، أما مانكون الجهة الادارية قد أعلنت عنه فعلا فانه من المستحسن اكمال النعاقد طبقا للاعلان حفظا لاستقرار المعاملات الادارية.

وتقبلوا تحياتنا...

وزير المالية والاقتصاد الوطني

محمد أبا الخيل

صورة مع الاساس للادارة القانونية الفيد ٣٣٩/م لغة :
صورة لكل ممثل مكتب
صورة لكل مستشار قانوني
صورة لمكتبنا.

# APPENDIX - B -

## **Ministry of Commerce' Requirements For Practicing Engineering in Saudi Arabia**

# القرارات الوزارية الخاصة بمزاولة المهنة واللجنة الهندسية

# قرار وزاري
## رقم (٢٦٤) وتاريخ ١٤٠٢/٩/١٦هـ الموافق ١٩٨٢/٧/٧م
## بتنظيم مزاولة مهنة الاستشارات الهندسية

إن وزير التجارة بما له من صلاحيات وبعد الاطلاع على نظام اختصاصات وزارة التجارة الصادر بقرار مجلس الوزراء رقم ٤٢٠ في ١٣٨٨/٦/١١هـ بشان تراخيص مزاوله مهنة الاستشارات الهندسية وعلى القرارات المكملة والمعدلة وبناء على مقتضيات المصلحة العامة يقرر خايلي :

مادة ١- تمنح تراخيص مزاولة مهنة الاستشارات الهندسية وفقا للقواعد والإجراءات المرافقة وذلك لحين صدور تنظيم جديد في هذا الشان .

مادة ٢- يلغي العمل بالقرار رقم ٤٢٠ في ١٣٨٨/٦/١١هـ والقرارات المكملة أو المعدلة له.

مادة ٣- يبلغ هذا القرار لمن يلزم لتنفيذه ويعمل به من تاريخ صدوره .

وزير التجارة

سليمان السليم

## الباب الأول
## قواعد وإجراءات مزاولة مهنة الاستشارات الهندسية

**الترخيص بمزاولة مهنة الاستشارات الهندسية :**

**مادة ١- يحظر على أي فرد أو مكتب أو شركه مزاولة جميع أعمال الاستشارات الهندسية الأبعد الحصول على ترخيص من الجهة المختصة بوزارة التجارة .**

**مادة ٢- يحظر تنفيذ المشاريع أو الأعمال الهندسية الا بموجب مخططات صادره من المرخص لهم بمزاولة الاستشارات الهندسية من وزارة التجارة .**

**مادة ٣- تمنح التراخيص للحاصلين على بكالوريوس من الشعب أو الفروع الهندسية التالية :**

**الشعب :**

١- شعبه هندسة العمارة والتخطيط .
٢- شعبه الهندسة المدنية .
٣- شعبه الهندسة الكهربائية .
٤- شعبه الهندسة الميكانيكية.
٥- شعبه هندسة المناجم والتعدين
٦- شعبه هندسة البترول (تنقيب)
٧- شعبه هندسة الكيميائية .
٨- شعبة الهندسة الزراعية .
٩- شعبه الهندسة الصناعية
١٠- شعبه هندسة النظم .
١١- شعبه هندسة اداره المشاريع .

**الفروع :**

**أولا: شعبه هندسة العمارة والتخطيط وتشمل الفروع التالية :**

١. فرع العمارة
٢. فرع اله ندسه المعمارية .

٣. فرع تخطيط المدن والأقاليم .
٤. فرع التصميم العمراني .
٥. فرع التصميم الداخلي .
٦. فرع تنسيق المواقع .
٧. فرع الترميم والمحافظة على الأثر.
٨. فرع هندسة البيئة .

ثانيا : شعبه الهندسة المدنية وتشمل الفروع التاليه :

١- فرع الهندسة المدنية .
٢- فرع هندسة الصحة (البيئية )
٣- فرع هندسة الري .
٤- فرع هندسة الطرق .
٥- فرع هندسة أل إنشاءات .
٦- فرع هندسة التربة.
٧- فرع هندسة المياه .
٨- فرع هندسة البلديات .
٩- فرع الهندسه الهيدرولوجيه.
١٠- فرع هندسة الموانئ
١١- فرع هندسة المطارات
١٢- فرع هندسة الاشغال العامة .
١٣- فرع هندسة المرور .
١٤- فرع هندسة حفظ التربة الزراعية.
١٥- فرع هندسة المساحة .
١٦- فرع هندسة الانفاق .

ثالثا : شعبه الهندسه الكهربائية وتشمل الفروع التالية :

١- فرع الهندسه الكهربائية .
٢- فرع هندسة القوى .
٣- فرع هندسة المواصلات .
٤- فرع الهندسه الالكترونيه .
٥- فرع هندسة الكهرباء الزراعية .

رابعا: شعبه الهندسة الميكانيكية وتشمل الفروع التالية :

١. الهندسه الميكانيكية .

٢. هندسة القوى والالات الحرارية .
٣. هندسة الانتاج الصناعي .
٤. هندسة السيارات .
٥. هندسة الطيران .
٦. هندسة التكييف والتبريد والتدفئه والتهويه .
٧. هندسة السفن .
٨. هندسة صنع السبائك .
٩. الهندسه النووية .
١٠. هندسة الالات الزراعية .
١١. هندسة ميكانيكية السوائل .

خامسا : شعبه هندسة المناجم والتعدين وتشمل الفروع التالية :

١. هندسة المناجم .
٢. هندسة استخلاص الفلزات .
٣. هندسة تركيب الخامات .
٤. الهندسه الجيل وجيه وتشمل
- جيولوجيا عامه .
- جيولوجيا تعدين .
- جيولوجيا بترول .
- جيلوجيا المياه الجوفية والسطحية .
- الجيوفيزياء .
- الجيوكيمياء .

سادسا : شعبه الهندسه الكيميائية وتشمل الفروع التالية :

١. فرع الهندسه الكيميائية .
٢. فرع هندسة الخزف .
٣. فرع هندسة التصنيع .
٤. فرع هندسة المعادن.
٥. فرع هندسة اللدائن (البلاستيك ).
٦. فرع هندسة البترول (تكرير)
٧. فرع هندسه النسيج .
٨. فرع هندسة المواد .

ويحق إضعافه فروع اخرى للشعب الهندسية المذكورة بقرار من وزير التجارة .

## الباب الثاني
## المهندسون والمكاتب والشركات السعودية .

**شروط الترخيص :**

**مادة (٤) يتم الترخيص وفقا للفئتين التاليتين :**

أ. المهندسون السعوديون .

ب. المكاتب الهندسية الاستشارية العامة والشركات التضامنية المهنية السعودية (المهندسون الاستشاريون ).

**مادة (٥) يتم الترخيص للمهندسين بالفئه (أ) وفقا للشروط التالية :**

١- أن يكون سعودي الجنسية .

٢- أن يقدم إقرارا خطيا بأنه لم يصدر ضده احكام بأدب المهنة

٣- أن يكون حاصلا على الاقل على درجه البكالوريوس في الهندسه من جامعة أو كليه أو معهد هندسي معترف به أو أي شهاده أخري معادلة .

٤- أن تكون لديه خبره عمليه معتمدة من أحد المكاتب الهندسية المرخصة بالمملكة أو خارجها أو احدى الجامعات أو المختبرات أو في وظيفه مناظره لدى الجهات الحكومية أو غيرها من الموسسات العامة أو الخاصة ذات العلاقه .

٥- أن يكون متفرغا .

**ماده(٦) تحدد مدد الخبرة وفقا للتالي :**

١- ثلاث سنوات لمن حصل على شهادة البكالوريوس في الهندسة أو ما يعادلها .

٢- سنتين لمن حصل على شهادة الماجستير في الهندسة أو ما يعادلها .

٣- سنه واحده لمن حصل على شهادة الدكتورة في الهندسة أو ما يعادلها .

**مادة (٧) يتم الترخيص للفئة (ب) وفقا للتالي :**

١- أن يكون صاحب المكتب أو الشركاء في الشركة مهندسون سعوديون .

٢- أن يتوافر لدى المكتب الهندسي أو الشركة مهندسون من ثلاث شعب هندسية على ألاقل .

اجراءات الترخيص :

مادة (٨) تقدم طلبات الترخيص إلى الجهه المختصة بوزاره التجارة على النموذج المعد لذلك وترفق بهذا الطلب المستندات المطلوبة لكل فئة مع ابراز المستندات الاصليه عند تقديم الطلب للاطلاع عليها واعادتها .

مادة (٩) في حاله الشركة التضامنية يرفق عقد الشراكه مسترشدا فيه بالنموذج الذي تعده وزاره التجارة

مادة (١٠) تفصل الجهه المختصة بوزاره التجارة في طلبات الترخيص خلال شهر من تاريخ تقديم الطلب وعليها إخطار طالب الترخيص بالقرار الصادر في طلبه وبالأسباب التي بني عليها في خلال عشره ايام على الاكثر من تاريخ صدوره بخطاب مسجل ولصاحب الطلب أن يتظلم من قرار رفض طلبه إلى وزير التجارة خلال ثلاثين يوما من تاريخ ابلاغه به ويكون قرار الوزير في هذا الشان نهائيا .

مادة(١١) يتعهد طالب الترخيص قبل مزاولته المهنة بان يقوم بعمله بكل امانه وصدق وتجرد وان يحافظ على أسرار المهنة كما يتعهد بتوفير الجهاز البشري الكافي بما يتفق وحجم العمل وطبيعته ويتم توقيع هذا التعهد لدى الجهه المختصة بوزارة التجارة .

تجديد الترخيص :

مادة (١٢) يعتبر الترخيص ساري المفعول لمدة ثلاث سنوات من تاريخ إصداره أو تجديده ويتم تجديد ا لترخيص وفقا للتالي :

١- التقدم بطلب التجديد قبل انتهاء مدته بمدة لاتقل عن شهرين .

٢- أن يرفق بطلب التجديد شهادة تسديد الزكاة .

احكام الترخيص :

مادة (١٣) يشمل الترخيص جميع انحاء المملكة ويشترط لفتح أي فرع مرور سنه على الاقل على الحصول على الترخيص ووجود مدير مرخص للفرع ويتم إشعار وزاره التجارة واللجنه الاستشارية الهندسية عن كافه الفروع ومكاتب الاتصال .

مادة (١٤) يتم الترخيص للمكاتب والشركات الهندسية الاستشارية باسم صاحبها أو أصحابها ويجوز أن يكون الاسم مشتقا من أغراض المهنة شريطه اقتران ذلك باسم صاحب أو اصحاب المكتب .

مادة (١٥) على كل مرخص أن تحمل لوحات مكتبه اسمه ومهنتـــه ورقـم ترخيصـــه وان يوضـــح مجـــال اختصاصه على جميع الاوراق والمطبوعات والرسومات والعقود التـــي تصـــدر منـــه فـــي أعمالـــه الهندسية .

مادة(١٦) لايجوز أن يكون للمرخص له أي مصلحه مباشرة أو غير مباشرة في أعمال التجارة أو المقـــاولات التي تتعلق بأعماله الهندسية أو بأي عمل يتعارض مع المهنة أو يخل بكرامتها .

مادة (١٧) على كل مرخص التوقيع على المخططات والرسومات والنماذج الصـــادرة مـــن مكتبـــه وفقـــا ل لتعليمات المتبعة لدى البلديات وان يحتفظ بمكتبه بأصول المخططات التى يعدها مبينا عليها التعديلات التي أقرتها الجهات المعنية مده لاتقل عن خمس سنوات بعد انتهاء التنفيذ .

مادة (١٨) يلتزم المكتب الهندسي باحترام الانظمه المعمول بها والقرارات الصادرة عن البلديات أو الجهات المعنية بشان الأعمال الهندسية التى يقوم بها وعليه أخطار البلديات أو الجـــهات المعنيـــة بشـــان الاعمال الهندسية التى يقوم بها وعليه إخطار البلديات أو الجهات المعنية فور اكتشافه أي مخالفه في تنفيذ الأعمال التي يشرف عليها .

# الباب الثالث

## المهندسون والمكاتب والشركات غير السعودية .

**شروط الترخيص :**

**مادة (١٩) يرخص للمهندسين والمكاتب والشركات غير السعودية وفقا للفئتين التاليتين :**

أ. المهندسين الأفراد غير السعوديين .

ب. المكاتب والشركات الهندسية غير سعوديه .

**مادة (٢٠) يتم الترخيص للفئة (أ) في الأماكن التي لا يتوافر فيها مهندسون سعوديون وفقا للشروط التاليه .**

١- آن يحمل طالب الترخيص أقامه نظاميه .

٢- آن يقدم شهادة بقيده في الهيئة المشرفة على المهنة في البلد الذي ينتمي الى تثبيت عضويته وتاريخ العضوية وعدم شطبها حتى تاريخ تقديم طلبه .

٣- آن يقدم شهادة من البلد الذي ينتمي إليه تنفيذ عدم صدور أحكام ضده تمس الشرف أو الامانه وانه مشهود له بحسن السيرة والسلوك .

٤- أن يكون حاصلا على درجه البكالوريوس في الهندسة من جامعه أو كليه أو معهد هندسي معترف به أو أي شهادة أخرى معادلة .

٥- أن تكون لديه خبرات عمليه في تخصصه من أحد مكاتب الهندسة المرخصة بالمملكة أو خارجها أو إحدى الجامعات أو المختبرات أو في عمل مماثل لدى الجهات الحكومية أو غيرها من الموسسات العامة والخاصة ذات العلاقة.

٦- أن يكون متفرغا .

**مادة (٢١) تحدد مدد الخبرة المطلوبة كتمايلي :**

١- ست سنوات لمن حصل على شهادة البكالوريوس في الهندسة أو ما يعادلها.

٢- أربع سنوات لمن حصل على شهادة الماجستير في الهندسة أو ما يعادلها .

٣- سنتان لمن حصل على شهادة الدك توراة في الهندسة أو ما يعادلها .

مادة (٢٢) يتم الترخيص ( فئة ب) للمكتب أو الشركة الأجنبية لمزاولة أعمال الاستشارات الهندسية في المملكة في مجال خبرتها السابقة فقط إذا اكتملت الشروط التالية :

١- أن يكون مرخصا للمكتب أو الشركة (ألام) بمزاوله نفس الأعمال في البلد الأصلي .

٢- أن يكون قد مضى على تكوين المكتب أو الشركة مده عشر سنوات مارست خلالها وبدون انقطاع اعمال الاستشارات الهندسية .

٣- أن تقدم الشركة (ألام) شهادة مصدقة تتعهد فيها بمسانده المكتب الذي يودى الأعمال باسمها في المملكة كما تتعهد ايضا بتحمل جميع التبعات والالتزامات التي تمليها النظم والتعليمات بالمملكة .

٤- شهادة من بنك مقبول لدى موسسه النقد العربي السعودي تحدد مقدرة الشركة وسمعتها المالية وتعاملها التجاري .

٥- بيان مصدق عن الأعمال التي قامت بها الشركة خارج المملكة في مجال المشروع الذي تقدمت لتنفيذه داخل المملكة.

٦- شهادات الاتجار التي حصلت عليها الشركة من الأعمال التي قامت بتنفيذها سواء داخل المملكة أو خارجها.

٧- صوره من ميزانية الشركة وحساب الأرباح والخسائر عن السنتين الأخيرتين مصدقة من مكتب محاسب قانوني معترف به .

إجراءات الترخيص :

مادة (٢٣) يقدم طلب الترخيص الى الجهة المختصة بوزارة التجارة على النموذج المعد لذلك مرفقا به المستندات التالية :

١- بيان بالأعمال الهندسية التي قام بها الطالب خلال العشر سنوات الماضية .

٢- تعهد بالعمل على مشاركة المهندسين السعوديين المرخصين في المواصفات التي يعدها .

٤- تعهد بالالتزام بتنفيذ كافه تعليمات الترخيص الواردة في هذا النظام وتعهد بالالتزام بجميع النظم والتعليمات التي تصدرها الجهات الحكومية المختلفة كل في مجاله واحترام التقاليد المرعية في المملكة اللزام جميع العاملين لديه بذلك .

مدة الترخيص :

مادة (٢٤) مدة الترخيص عامان هجريان .

مادة (٢٥) يجدد الترخيص لمده مماثلة بناء على طلب المرخص يقدم قبل انتهاء المدة بشهرين على الأقـــل مرفقا به ما يأتي :

١- شهادة دفع الزكاة والضرائب المستحقة عليه لمصلحه الزكاة والدخل .

٢- تفصيل للأعمال التي قام بها في السنة الماضية وأتعابـــها ومقـدار مشـــاركة الاستشـــاريين السعوديين في تلك الأعمال وأتعابهم .

٣- تصديق شهادات الأداء من الجهات الحكومية التي أدى لها أعمالا في المدة السالفة .

مادة (٢٦) يتم فض المنازعات التي تنشا في المملكة بين الاستشاريين الأجانب أو بينهم وبين الاستشـــاريين السعوديين في المملكة وفقا لنظمة والتعليمات المعمول بها في المملكة .

# APPENDIX – C -

****Sample of public owners' current prequalification and selection practice****

**Ministry of defense- GDMW- current prequalification **

المملكة العربية السعودية
وزارة الدفاع والطيران والتفتيش العامة
الإدارة العامة للأشغال العسكرية
إدارة المشاريع - قسم المساندة الفنية


# نموذج تأهيل المكاتب الإستشارية

١- أسم المكتب الاستشاري أو الشركة: _____ ١-١ إسم المالك: _____

٢- مكان وتاريخ المكتب: _____

٣- نوع المكتب: ☐ خاص ☐ شركة ☐ شركة مساهمة ☐ شركة تضامنية ☐ أخرى

٤- إسم المكتب (سابقاً إن وجد): _____

٥- عنوان المكتب ص ب: _____ المدينة: _____ الرمز البريدي: _____

تلفون: _____ فاكس: _____ تلكس: _____

العنوان البرقي: _____

٦- فروع المكتب:

١- فرع المكتب: ص ب: _____ المدينة: _____ الرمز البريدي: _____

تلفون: _____ فاكس: _____ تلكس: _____

إسم الشخص المسئول: _____

٢- فرع المكتب: ص ب: _____ المدينة: _____ الرمز البريدي: _____

تلفون: _____ فاكس: _____ تلكس: _____

إسم الشخص المسئول: _____

٣- فرع المكتب: ص ب: _____ المدينة: _____ الرمز البريدي: _____

تلفون: _____ فاكس: _____ تلكس: _____

إسم الشخص المسئول: _____

٧- منسوبو المكتب:

| ٧-١ | أسماء الأشخاص الرئيسيين الذين يمثلون المكتب في المملكة: |
|---|---|
| | • _____ الوظيفة: _____ |
| | • _____ الوظيفة: _____ |
| | • _____ الوظيفة: _____ |
| | • _____ الوظيفة: _____ |
| | • _____ الوظيفة: _____ |
| | • _____ الوظيفة: _____ |

| | |
|---|---|
| ٧-٢ | المعمـــاريون |
| | |
| ٧-٣ | المهندســـون الإنشائيون |
| | |
| ٧-٤ | المهندســـون الكهربائيون |
| | |
| ٧-٥ | مهندسو أعمـــال البـــتة و التزيين |
| | |
| ٧-٦ | مهندسو الأعمـــال الصحية ( يذكر بالتحديد) |
| | |
| ٧-٧ | مهندسو التخطيط ( خصوصا مهندسو المواقع ، المدن ، الخ ) |
| | |

| | |
|---|---|
| ٧-٨ | المهندسون المدنيون |
| | |
| ٧-٩ | المهندسون الميكانيكيون |
| | |
| ٧-١٠ | أسماء الأشخاص الرئيسيين الآخرين ( يذكر بالتحديد) |
| | |

٨- عدد العاملين في المكتب:

(أ) الموظفون الرئيسيون : _____

(ب) الموظفون الآخرون : _____

| | المركز الرئيسي | المكاتب الفرعية | المكاتب في الخارج | المجموع |
|---|---|---|---|---|
| المعماريون | | | | |
| مهندسون مدنيون | | | | |
| مهندسون كهربائيون | | | | |
| مهندسون ميكانيكيون | | | | |
| آخرون ( أذكر التخصص) | | | | |
| رساهون | | | | |
| أخصائيو الموصفات | | | | |
| أخصائيو التقديرات | | | | |
| مفتش جوده | | | | |
| المساحون | | | | |
| آخرون ( اذكر التخصص) | | | | |

ملخص:

| | معمـــاريون | مهندســـون | المجموع |
|---|---|---|---|
| المركز الرئيسي | | | |
| المكاتب الفرعية | | | |

| ٩- | عدد الموظفين في مكتبكم خلال الخمس سنوات الماضية: | |
|---|---|---|
| | أ- أكبر عدد من الموظفين وصل الى: | ـــــــ كان عام ـــــــــ |
| | ب- العدد الطبيعي للموظفين: | ـــــــــــــــــــــ |

| ١٠- | هيئات أو مكاتب إستشارية يتم التعاون معهم: | |
|---|---|---|
| | التخصص (المجال) | أسم المكتب أو الشخص و عنوانه |
| | أ- معماري | |
| | ب- ميكانيكا | |
| | جـ- تنسيق مواقع معماري | |
| | د- كهربائي | |
| | ه- مدني | |
| | و- تخطيط | |
| | ز- إنشائي | |
| | حـ- تقديرات | |
| | ط- سباكة | |
| | ي- متطلبات إستشارية آخرى | |

| ١١- | أذكر بالترتيب الأفضلية باستعمال الأرقام ١، ٢ ، ٣ ....الخ ، أنواع المشاريع التي يتخصص بها المكتب<br>( واذا لم يكن التصنيف ادناه مطابقا لتخصص المكتب ، يذكر لتخصص في الفراغات المخصصة لهذا الغرض) | |
|---|---|---|
| | ☐ مرافق المطارات | ☐ |
| | ☐ التكييف و التبريد والتهوية | ☐ |
| | ☐ الجســـور و الســـــدود | ☐ |
| | ☐ الإتصالات | ☐ |
| | ☐ المباني التجارية | ☐ |
| | ☐ المباني المكتبية | ☐ |
| | ☐ المرافق الإلكترونية | ☐ |
| | ☐ مرافق المون | ☐ |
| | ☐ الطـــــرق | ☐ |
| | ☐ المســـتشـــفيات | ☐ |
| | ☐ الإســـكان | ☐ |
| | ☐ المباني الصنـــاعية | ☐ |
| | ☐ مياه و مجاري | ☐ |
| | ☐ مباني عامة | ☐ |
| | ☐ ميادين الرماية | ☐ |
| | ☐ | ☐ |
| | ☐ | ☐ |
| | ☐ | ☐ |
| | ☐ | ☐ |
| | ☐ | ☐ |

| ١٢- | معلومات شخصية عن الأشخاص الرئيسين في المكتب (أذكر المعلومات بالتفصيل بحدود ما هو ضروري) |
|---|---|

| الأسم: | | | |
|---|---|---|---|
| تاريخ الميلاد | سنوات الخبرة | كمسئول رئيسي في مكاتب أخرى | كمسئول رئيسي في هذا المكتب |
| | | | |

| المؤهل العلمي | إسم الجامعة | السنة | التقدير |
|---|---|---|---|
| | | | |

| العضوية في الهيئات المهنية: | | | |
|---|---|---|---|
| الترخيص | التخصص | السنة | المرحلة |
| | | | |

| الأسم: | | | |
|---|---|---|---|
| تاريخ الميلاد | سنوات الخبرة | كمسئول رئيسي في مكاتب أخرى | كمسئول رئيسي في هذا المكتب |
| | | | |

| المؤهل العلمي | إسم الجامعة | السنة | التقدير |
|---|---|---|---|
| | | | |

| العضوية في الهيئات المهنية: | | | |
|---|---|---|---|
| الترخيص | التخصص | السنة | المرحلة |
| | | | |

| ١٣- | الأعمـــال التي يقوم الإستشاري بتنفيذها | | |
|---|---|---|---|
| إسم المشروع و مكوناته | الموقع | إسم و عنوان المالك | تكاليف الإنشاء التقديرية |
| | | | |
| | | | النسبة المنجزة |
| | | | تصميم / إشراف |
| | | | |
| إسم المشروع و مكوناته | الموقع | إسم و عنوان المالك | تكاليف الإنشاء التقديرية |
| | | | |
| | | | النسبة المنجزة |
| | | | تصميم / إشراف |
| | | | |
| إسم المشروع و مكوناته | الموقع | إسم و عنوان المالك | تكاليف الإنشاء التقديرية |
| | | | |
| | | | النسبة المنجزة |
| | | | تصميم / إشراف |
| | | | |
| إسم المشروع و مكوناته | الموقع | إسم و عنوان المالك | تكاليف الإنشاء التقديرية |
| | | | |
| | | | النسبة المنجزة |
| | | | تصميم / إشراف |
| | | | |
| إسم المشروع و مكوناته | الموقع | إسم و عنوان المالك | تكاليف الإنشاء التقديرية |
| | | | |
| | | | النسبة المنجزة |
| | | | تصميم / إشراف |
| | | | |
| المجموع الكلي للمشـــاريع الحـــالية | | المجموع الكلي لتكاليف الإنشـــاء | |

| ١٤- | الأعمال الحالية التي يقوم المكتب بتنفيذها بالمشاركة مع الآخرين ( إذكر المرحلة التي يقوم المكتب بتنفيذها) | | | |
|---|---|---|---|---|
| إسم المشروع و مرحلة العمل | تكاليف الإنشاء التقديرية | | الشركة المعاون معها | |
| | المشروع بالكامل | الجزء من المشروع الذي يقوم المكتب بتنفيذه | | |
| | | | | |
| | الملك | الموقع | نسبة العمل المنجزة من المشروع | |
| | | | تصميم | إشراف |
| | | | | |
| إسم المشروع و مرحلة العمل | تكاليف الإنشاء التقديرية | | الشركة المعاون معها | |
| | المشروع بالكامل | الجزء من المشروع الذي يقوم المكتب بتنفيذه | | |
| | | | | |
| | الملك | الموقع | نسبة العمل المنجزة من المشروع | |
| | | | تصميم | إشراف |
| | | | | |
| إسم المشروع و مرحلة العمل | تكاليف الإنشاء التقديرية | | الشركة المعاون معها | |
| | المشروع بالكامل | الجزء من المشروع الذي يقوم المكتب بتنفيذه | | |
| | | | | |
| | الملك | الموقع | نسبة العمل المنجزة من المشروع | |
| | | | تصميم | إشراف |
| | | | | |
| إسم المشروع و مرحلة العمل | تكاليف الإنشاء التقديرية | | الشركة المعاون معها | |
| | المشروع بالكامل | الجزء من المشروع الذي يقوم المكتب بتنفيذه | | |
| | | | | |
| | الملك | الموقع | نسبة العمل المنجزة من المشروع | |
| | | | تصميم | إشراف |
| | | | | |
| تكاليف الإنشاء التقديرية | التكاليف التقديرية للإنشاء للجزء الذي يقوم المكتب بتنفيذه | | | |

| ١٥- | الأعمال المنتهية التي قام المكتب بتنفيذها خلال العشر سنوات الماضية | | | | |
|---|---|---|---|---|---|
| إسم المشروع و مكوناته | الموقع | سنة التنفيذ | إسم و عنوان المالك | تكاليف الإنشاء التقديرية | هل تم إنشاؤه نعم أم لا |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| المجموع الكلي للمشاريع : | | | المجموع الكلي لتكاليف الإنشاء التقديرية | | |

١٦- أود / نود التأهل للأعمـــال المعمارية أو أعمال الخدمات الهندسية فيما يتعلق بـــ:

☐ التصميم ☐ التنسيق ☐ الإشـــراف ( إختر المناسب) على أعمال الإنشاء

| أسم الشخص المسئول في المكتب | المركز | التوقيع |
|---|---|---|
| | | |

تعليمات عامة:-

أ- يعبأ هذا النموذج طباعة ، يمكن عمل نسخ من هذا النموذج بعد تعبئته حسب الحاجة.

ب- من الأفضل للمكتب مقدم الطلب الإحتفاظ بسجل الخبرة بصورة محدثة و يمكن عمل هذا بتقديـــم معلومات إضـــافية من حين إلى آخر.

جـ- يجب أن تشتمل كاتالوجات المكتب على صور من المشاريع الهمة التي قام المكتب بتنفيذها.

د- إذا كانت الفراغات في هذا النموذج غير كافية أو أردت تقديم معلومات إضـــافية فيمكن عمل ذلك على ورقة إضـــافية أخرى شريطة أن يذكر الرقم المشار إليه.

# **Application for Registration of Consultants With Islamic Development Bank**

بسم الله الرحمن الرحيم

# APPLICATION FOR REGISTRATION OF CONSULTANTS

# WITH

# ISLAMIC DEVELOPMENT BANK

**PART A. FIRM DESCRIPTION**

**1-10. NAME, ADDRESS, TYPE OF ORGANIZATION...**

## CONSULTING FIRM REGISTRATION FORM

| | |
|---|---|
| | Date (month, day, year) / / |
| 1. Name of Firm (full name) | Acronym (if any) |
| | Year Established |
| 2. Address of Home Office | |
| Street Address | Telephone No. |
| City, Country | Cable Address |
| P.O. Box (if any) / State Province | Telex No. |
| Postal Code / Country | Country Code |
| Officer(s) or Partner(s) to be Contacted (name, title) | |
| | |
| Address of Officer(s) or Partner(s) to be Contacted, if Different From Above (check this space if address is different from above) ☐ | |
| 1. Former Name(s) of Firm (full name) | Acronym (if any) |
| | Year Established |
| | Acronym (if any) |
| | Year Established |

4. Type of Organization (check one of the space below)

| a. Partnership Firm | b. Private Company | c. Public Corporation | d. Government Assisted Firm | e. State Enterprise | f. Other |
|---|---|---|---|---|---|
| | | | | | |

Is this either a group firm formed by its member firms, or a parent firm with subsidiaries? ☐ Yes ☐ No

Is this firm owned wholly or partly by, or does this firm wholly or Partly own, an organization engaged in manufacturing, Construction or product processing. ☐ Yes ☐ No

5. **Sectors in Which Firms Specializes**
(check appropriate spaces to indicate Sectors for which item 18 Fields of Specialization pages are included: see page 9 for key to Sector codes and pages 16 to 56 for Fields of Specialization within each sector.)

| AG | CO | ED | EG | EV | HE | IN | PO | TE | TO | TR | UD | WS | MS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | |

6. **No. of Project Description Sheets**
(enter total number of Project Description Sheets included in item 20, page 61) ☐☐☐

7. **Narrative Description of Form**
(check this space if Narrative Description of Firm is included in attachment 1 page 65) ☐

8. **Partners, Directors, Officers and Key Personnel**
(check this space if information on Partners, Directors, Officers and Key Personnel is included in attachment 2, page 67) ☐

9. **Firm Ownership and Nationality**
(check this space if information on Firm Ownership and Nationality is included in Attachment 3 page 69) ☐

10. **Firm Membership in Professional Associations** (state acronyms here, full names with acronyms in Attachment 1, page 65)

As of this date the information furnished in this form is accurate and true to the best of my knowledge.

(name and title of person signing) (signature)

This form is accepted by the following institutions:

| | | | | | |
|---|---|---|---|---|---|
| ADB | Asian Development Bank | IBRD, IDA, IFC | World Bank Group | KFAED | Kuwait Fund for Arab Economic Development |
| ADFAED | Abu Dhabi Fund for Arab Economic Development | IDB | InterAmerican Development Bank | UNDP | United Nations Development Program |
| BADEA | Arab Bank for Economic Development in Africa | | | UNIDO | United Nations Industrial Development Organization |
| | | | | WHO | World Health Organization |

Also the form is endorsed by the following international associations the Federacion Latino Americana de Asociaciones de Consultores (FELAC). The international Federation of Consulting Engineers (FIDIC), and the European Committee of Consulting Engineering Firms (CEBI).

## PART A. FIRM DESCRIPTION

### 11. AFFILIATED FIRMS

11. Firms with which the Registering Firm is Affiliated (see Explanation for item 11, page 4)

| No.[1] | Full Name | Acronym (if any) | Type of Affiliate[2] | Type 3 Affiliates Data Included[3] | Country Code[4] |
|---|---|---|---|---|---|
| | | | | | |

## PART A. FIRM DESCRIPTION

## 12. BRANCH OFFICES

12. Countries Outside Home Country in Which Firm/Entity has Branch Offices[1] (check appropriate spaces)

| | CODES | COUNTRIES | | CODES | COUNTRIES | | CODES | COUNTRIES |
|---|---|---|---|---|---|---|---|---|
| | AF | Afghanistan | | GRD | Granada | | PNG | Papua New Guinea |
| | ALB | Albania | | GU | Guatemala | | PA | Paraguay |
| | AL | Algeria | | GUI | Guinea | | PE | Peru |
| | ANG | Angola | | GUB | Guinea - Bissau | | PH | Philippines |
| | AR | Argentina | | GUA | Guyana | | POL | Poland |
| | AU | Australia | | HA | Haiti | | PO | Portugal |
| | AUA | Austria | | HO | Honduras | | QA | Qatar |
| | BM | Bahamas | | HK | Hong Kong | | RC | Romania |
| | BH | Bahrain | | HUN | Hungary | | RW | Rwanda |
| | BD | Bangladesh | | IC | Iceland | | STP | Sao Tome and Principe |
| | BAR | Barbados | | IN | India | | SAU | Saudi Arabia |
| | BE | Belgium | | IND | Indonesia | | SE | Senegal |
| | BEN | Benin | | IRN | Iran | | SEY | Seychelles |
| | BHU | Bhutan | | IRQ | Iraq | | SL | Sierra Leone |
| | BO | Bolivia | | IRE | Ireland | | SI | Singapore |
| | BT | Botswana | | IS | Israel | | SOL | Solomon Islands |
| | BR | Brazil | | IT | Italy | | SO | Somalia |
| | BUL | Bulgaria | | IVC | Ivory Coast | | SA | South Africa |
| | BA | Burma | | JM | Jamaica | | SP | Spain |
| | BU | Burundi | | JA | Japan | | CE | Sri Lanka |
| | BYE | Byelorussia | | JO | Jordan | | SU | Sudan |
| | CM | Cameron | | KH | Kampuchea | | SUR | Suriname |
| | CAN | Canada | | KE | Kenya | | SW | Swaziland |
| | CV | Cape Verde | | KO | Korea | | SWE | Sweden |
| | CA | Central African Empire | | KU | Kuwait | | SWI | Switzerland |
| | CD | Chad | | LA | Laos | | SYR | Syria |
| | CH | Chile | | LE | Lebanon | | TA | Tanzania |
| | CHN | China, People's Republic of | | LSO | Lesotho | | TH | Thailand |
| | CHA | China, (Taiwan) Republic of | | LBR | Liberia | | TO | Togo |
| | CO | Columbia | | LBY | Libya | | TR | Trinidad and Tobago |
| | COM | Comoros | | LU | Luxembourg | | TUN | Tunisia |
| | COB | Congo | | MAG | Madagascar | | TU | Turkey |
| | CR | Costa Rica | | MAI | Malawi | | UG | Uganda |
| | CUB | Cuba | | MA | Malaysia | | UKR | Ukraine |
| | CY | Cyprus | | MAL | Maldives | | USS | Union of Soviet Socialist Republics |
| | CZE | Czechoslovakia | | MLI | Mali | | UAE | United Arab Emirates |
| | DE | Denmark | | MAT | Malta | | UK | United Kingdom |
| | DI | Djibouti | | MAU | Mauritania | | USA | United States |
| | DO | Dominican Republic | | MAS | Mauritius | | UV | Upper Volta |
| | EC | Ecuador | | ME | Mexico | | UR | Uruguay |
| | EGT | Egypt | | MNG | Mongolia | | VE | Venezuela |
| | ES | El Salvador | | MOR | Morocco | | VN | Vietnam |
| | EG | Equatorial Guinea | | MOZ | Mozambique | | WSO | Western Samoa |
| | ET | Ethiopia | | NEP | Nepal | | YAR | Yemen Arab Republic |
| | FIJ | Fiji | | NE | Netherlands | | YDR | Yemen, Democratic Republic of |
| | FI | Finland | | NZ | New Zealand | | YU | Yugoslavia |
| | FR | France | | NI | Nicaragua | | ZR | Zaire |
| | GA | Gabon | | NIR | Niger | | ZA | Zambia |
| | GM | Gambia | | UNI | Nigeria | | Other (Specify) | |
| | GDR | Germany, Democratic Republic of | | NO | Norway | | XX | |
| | WEG | Germany, Federal Republic of | | OM | Oman | | YY | |
| | GH | Ghana | | PAK | Pakistan | | ZZ | |
| | GR | Greece | | PAN | Panama | | | |

## PART A. FIRM DESCRIPTION

## 13-16 PERSONNEL, LANGUAGE CAPABILITY, FEES, BANK REFERENCES

13. Personnel of Firm / Entity by Broad Occupational Groups (see Explanation for item 13. Page 4)

| a. Agriculturists | | b. Sociologists | | c. Architects and Urban Planners | | d. Biologists and Chemists | | e. Credit Specialists, Financial Analysts and Accountants | | f. Economists | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| full-time | part-time | full-time | part-time | full-time | part-time | full-time | part-time | full-time | part-time | full-time | part-time |
| | | | | | | | | | | | |

| g. Engineers | | h. Educators and Training Specialists | | i. Health and Population Specialists | | j. Operations and Management Specialists | | k. Science and Technology Specialists | | l. Surveyors, Estimators and Inspectors | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| full-time | part-time | full-time | part-time | full-time | part-time | full-time | part-time | full-time | part-time | full-time | part-time |
| | | | | | | | | | | | |

| m. Technicians and Draftsmen | | n. Administrative and Support Staff | | o. Other (specify) | | p. Other (Specify) | | q. Other (specify) | | r. Grand Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| full-time | part-time | full-time | part-time | full-time | part-time | full-time | part-time | full-time | part-time | full-time | part-time |
| | | | | | | | | | | | |

14. Language Capability of Professional Personnel of Firm / Entity (see Explanation for item 14, Page 4)

| | a. English | | b. French | | c. Spanish | | d. Portuguese | | e. Arabic | |
|---|---|---|---|---|---|---|---|---|---|---|
| | full-time | part-time | full-time | part-time | full-time | part-time | full-time | part-time | full-time | part-time |
| Mother Tongue | | | | | | | | | | |
| Acquired Language | | | | | | | | | | |

| | f. Other (specify) | | g. Other (specify) | | h. Other (specify) | | i. other (specify) | | j. Other (specify) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | full-time | part-time | full-time | part-time | full-time | part-time | full-time | part-time | full-time | part-time |
| Mother Tongue | | | | | | | | | | |
| Acquired Language | | | | | | | | | | |

15. Annual Volume of Gross Fees of Firm/Entity

| (enter fees for last five full years preceding form submission date.) | Year | | Annual Volume of Gross Fees (in US$ millions to 2 decimal places) | | |
|---|---|---|---|---|---|
| | | | As Prime Consulting Firm | As Associate and / or Joint Venture Firm[1] | Total |
| | 1980 | US$m | • | • | • |
| | 1979 | US$m | • | • | • |
| | 1978 | US$m | • | • | • |
| | 1977 | US$m | • | • | • |
| | 1976 | US$m | • | • | • |
| | 1975 | US$m | • | • | • |
| | 1974 | US$m | • | • | • |
| | | | | Grand Total | • |

Include only your firm entity's portion of fees earned as an associate and or joint venture firm

16. Bank or Other Financial Reference(s) of Firm/Entity (enter name and full address for each reference)

## PART B. FIRM CAPABILITY

### 17. TYPES OF SERVICES BY SECTOR

| CODES | TYPES OF SERVICES | Sectors of Specialization (see pages 15 to 56) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | AGRICULTURAL AND RURAL DEVELOPMENT | CONSTRUCTION INDUSTRY DEVELOPMENT | EDUCATION | ENERGY | ENVIRONMENT | HEALTH | INDUSTRY | POPULATION | TELECOMMUNICATIONS | TOURISM | TRANSPORTATION | URBAN DEVELOPMENT | WATER SUPPLY AND SANITATION | MISCELLANEOUS |
| | | AG | CO | ED | EG | EV | HE | IN | PO | TE | TO | TR | UD | WS | MS |
| 1a | Aerial Surveys, Satellite Imagery | | | | | | | | | | | | | | |
| 1b | Geological Surveys | | | | | | | | | | | | | | |
| 1c | Geophysical Surveys | | | | | | | | | | | | | | |
| 1d | Hydrological Surveys | | | | | | | | | | | | | | |
| 1e | Hydrographic Surveys | | | | | | | | | | | | | | |
| 1f | Soil Surveys | | | | | | | | | | | | | | |
| 1g | Topographic Surveys | | | | | | | | | | | | | | |
| 1h | Resources Surveys | | | | | | | | | | | | | | |
| Other (specify) | | | | | | | | | | | | | | | |
| 1i | | | | | | | | | | | | | | | |
| 1j | | | | | | | | | | | | | | | |
| 1k | | | | | | | | | | | | | | | |
| 2a | Sector Studies | | | | | | | | | | | | | | |
| 2b | Policy Studies | | | | | | | | | | | | | | |
| 2c | Regional Development Plans | | | | | | | | | | | | | | |
| Other (Specify) | | | | | | | | | | | | | | | |
| 2d | | | | | | | | | | | | | | | |
| 2e | | | | | | | | | | | | | | | |
| 2f | | | | | | | | | | | | | | | |
| 3a | Planning Studies | | | | | | | | | | | | | | |
| 3b | Feasibility Studies | | | | | | | | | | | | | | |
| 3c | Market Studies | | | | | | | | | | | | | | |
| 3d | Economic Studies | | | | | | | | | | | | | | |
| 3e | Financial Studies | | | | | | | | | | | | | | |
| 3f | Tariff Studies | | | | | | | | | | | | | | |
| 3g | Technical Studies | | | | | | | | | | | | | | |
| 3h | Operations Studies | | | | | | | | | | | | | | |
| 3i | Environmental Studies | | | | | | | | | | | | | | |
| 3j | Sociological Studies | | | | | | | | | | | | | | |
| 3k | Research Design / Evaluation | | | | | | | | | | | | | | |
| Other (specify) | | | | | | | | | | | | | | | |
| 3l | | | | | | | | | | | | | | | |
| 3m | | | | | | | | | | | | | | | |
| 3n | | | | | | | | | | | | | | | |
| 4a | Design –Architectural, Engineering, Industrial, Etc. | | | | | | | | | | | | | | |
| 4b | Social Mechanics Studies and Engineering | | | | | | | | | | | | | | |
| 4c | Hydraulic Studies and Engineering | | | | | | | | | | | | | | |
| 4d | Earthquake Engineering | | | | | | | | | | | | | | |
| 4e | Sabo (Landslide Protection) Engineering | | | | | | | | | | | | | | |
| 4f | Quantity Surveying, Cost Estimating | | | | | | | | | | | | | | |
| 4g | Estimation, Preparation of Contract Documents and Bid Evaluation | | | | | | | | | | | | | | |
| Other (Specify) | | | | | | | | | | | | | | | |
| 4h | | | | | | | | | | | | | | | |
| 4i | | | | | | | | | | | | | | | |
| 4j | | | | | | | | | | | | | | | |
| 5a | Procurement Services | | | | | | | | | | | | | | |
| 5b | Supervision / Inspection of Construction | | | | | | | | | | | | | | |
| 5c | Supervision / Inspection of Equipment Installation | | | | | | | | | | | | | | |
| 5d | Project Management (Management on Behalf of Owner) | | | | | | | | | | | | | | |
| 5e | Technical Assistance and Advisory Services | | | | | | | | | | | | | | |
| 5f | Turnkey Operations | | | | | | | | | | | | | | |
| 5g | Start-Up Operations | | | | | | | | | | | | | | |
| Other (specify) | | | | | | | | | | | | | | | |
| 5h | | | | | | | | | | | | | | | |
| 5i | | | | | | | | | | | | | | | |
| 5j | | | | | | | | | | | | | | | |

## PART B. FIRM CAPABILITY

### 17. TYPES OF SERVICES BY SECTOR

| CODES | TYPES OF SERVICES | Sectors of Specialization (see pages 15 to 56) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | AGRICULTURAL AND RURAL DEVELOPMENT | CONSTRUCTION INDUSTRY DEVELOPMENT | EDUCATION | ENERGY | ENVIRONMENT | HEALTH | INDUSTRY | POPULATION | TELECOMMUNICATIONS | TOURISM | TRANSPORTATION | URBAN DEVELOPMENT | WATER SUPPLY AND SANITATION | MISCELLANEOUS |
| | | AG | CO | ED | EG | EV | HE | IN | PO | TE | TO | TR | UD | WS | MS |
| 6a | Product and Production Technology | | | | | | | | | | | | | | |
| 6b | Production Management | | | | | | | | | | | | | | |
| 6c | Process Evaluation and Selection | | | | | | | | | | | | | | |
| 6d | Quality Control | | | | | | | | | | | | | | |
| 6e | Marketing and Distribution | | | | | | | | | | | | | | |
| 6f | Packaging and Storage | | | | | | | | | | | | | | |
| 6g | Warehousing and Inventory Control | | | | | | | | | | | | | | |
| 6h | Physical Distribution and Shipping | | | | | | | | | | | | | | |
| Other (specify) | | | | | | | | | | | | | | | |
| 6i | | | | | | | | | | | | | | | |
| 6j | | | | | | | | | | | | | | | |
| 6k | | | | | | | | | | | | | | | |
| 7a | Operations and Maintenance | | | | | | | | | | | | | | |
| 7b | Maintenance Planning | | | | | | | | | | | | | | |
| 7c | Equipment / Plant Rehabilitation | | | | | | | | | | | | | | |
| 7d | Plant / Factory Rehabilitation | | | | | | | | | | | | | | |
| 7e | Civil Works Rehabilitation | | | | | | | | | | | | | | |
| Other (specify) | | | | | | | | | | | | | | | |
| 7f | | | | | | | | | | | | | | | |
| 7g | | | | | | | | | | | | | | | |
| 7h | | | | | | | | | | | | | | | |
| 8a | Accounting / Auditing | | | | | | | | | | | | | | |
| 8b | Information Systems and Computer Processing | | | | | | | | | | | | | | |
| 8c | Computer Technology | | | | | | | | | | | | | | |
| Other (specify) | | | | | | | | | | | | | | | |
| 8d | | | | | | | | | | | | | | | |
| 8e | | | | | | | | | | | | | | | |
| 8f | | | | | | | | | | | | | | | |
| 9a | Institutional Strengthening | | | | | | | | | | | | | | |
| 9b | Management Advisory Services | | | | | | | | | | | | | | |
| 9c | Management Studies | | | | | | | | | | | | | | |
| 9d | Organizational Development Studies | | | | | | | | | | | | | | |
| 9e | Manpower Requirements Studies | | | | | | | | | | | | | | |
| 9f | Training and Transfer of Technology | | | | | | | | | | | | | | |
| Other (specify) | | | | | | | | | | | | | | | |
| 9g | | | | | | | | | | | | | | | |
| 9h | | | | | | | | | | | | | | | |
| 9i | | | | | | | | | | | | | | | |

**PART B. FIRM CAPABILITY**
**FIELDS OF SPECIALIZATION**

## CO – Construction Industry Development Sector

| | CODES | FIELDS OF SPECIALIZATION |
|---|---|---|
| | B100 | General |
| | B101 | Institution Building |
| | B102 | Contractors Trade Associations |
| | B13 | Labor Issues, Labor Organizations |
| | Other (Specify) | |
| | B104 | |
| | B105 | |
| | B106 | |
| | B200 | Construction Management |
| | B201 | Force Account, Department Capacity Development |
| | B202 | Development of Construction Capacity of Community Organizations |
| | B203 | Corporate Firm Management |
| | B203a | General |
| | B203b | Technical |
| | B203c | Commercial |
| | B204 | Site Management, Work Execution |
| | B204a | Buildings |
| | B204b | Civil Works |
| | B204c | Special Works (Industrial Plants, Etc.) |
| | B205 | Construction Engineering |
| | Other (Specify) | |
| | B206 | |
| | B207 | |
| | B208 | |
| | B300 | Technology, Equipment, Materials and Training |
| | B301 | Development of Appropriate Construction Technology |
| | B301a | Labor-Based Construction and Maintenance Methods |
| | B301b | Low - Cost Construction Techniques |
| | B302 | Equipment |
| | B302a | Mechanical |
| | B302b | User |
| | B302c | Rental (Equipment Pools) |
| | B303 | Materials |
| | B303a | Use of Domestic Materials |
| | B304 | Training |
| | B304a | Management |
| | B304b | Trades |
| | Other (Specify) | |
| | B305 | |
| | B306 | |
| | B307 | |
| | B400 | Finance, Insurance and Bonding |
| | B401 | Financial Institutions, Bonding Insurance |
| | B401a | Credit |
| | B401b | Contractor's Bonding |
| | B401c | Contractor's Insurance |
| | B401d | Financing of Equipment Pools |
| | Other (Specify) | |
| | B402 | |
| | B403 | |
| | B404 | |

**PART B. FIRM CAPABILITY**
**FIELDS OF SPECIALIZATION**

## TR – Transportation Sector

| CODES | FIELDS OF SPECIALIZATION |
|---|---|
| K100 | General |
| K101 | National/Regional Multimodal Transportation Planning |
| K101a | Traffic Origin-Destination Surveys |
| K101b | Information Systems |
| K101c | Demand Forecasting |
| K101d | Transportation Models |
| K101e | Policies and Investment Programs |
| K102 | Intermodal Transportation Technology |
| K103 | Intermodal Freight Terminals |
| K104 | Facilitation (simplification of transportation documents procedures etc.) |
| Other (Specify) | |
| K105 | |
| K106 | |
| K107 | |
| K200 | Road Transportation Facilities |
| K201 | Highway Planning and Programming |
| K201a | Highways |
| K201b | Rural Feeder Roads (Farm to Market) |
| K202 | New Highways, Improvements and Reconstruction |
| K202a | Toll Roads |
| K202b | Primary Roads |
| K202c | Secondary Roads |
| K202d | Rural Feeder Roads (Farm to Market) |
| K202e | Access Tracks |
| K203 | New Structures, Reconstruction |
| K203a | Bridges |
| K203b | Tunnels |
| K203c | Interchanges |
| K203d | Ferry Structures |
| K204 | Maintenance of Highways |
| K204a | Organization, Funding and Programming |
| K204b | Execution |
| K205 | Maintenance of Rural Feeder Roads (Farm to Market) |
| K205a | Organization, Funding and Programming |
| K205b | Execution |
| K206 | Equipment / Plant Management |
| K207 | Highway Traffic Control |
| K208 | Highway Legislation |
| K209 | Highway Safety |
| Other (Specify) | |
| K210 | |
| K211 | |
| K212 | |
| K300 | Road Transportation Industry |
| K301 | Regulation |
| K302 | Road User Charges |
| K303 | Management of Firms |
| K303a | Passenger Transportation |
| K303b | Freight Transportation |
| K304 | Financial Analysis, Costing and Tariffs |
| K305 | Terminals |
| K305a | Passenger |
| K305b | Freight |
| K306 | Rural Transportation Services |
| K306a | Passenger Transportation |
| K306b | Freight Transportation |
| Other (Specify) | |
| K307 | |
| K308 | |
| K309 | |
| K400 | Trail Transportation |
| K401 | Demand Forecasting and Investment Planning |
| K402 | Marketing |
| K403 | Financial Analysis, Costing and Tariffs |
| K404 | Regulation and Pricing |
| K405 | Management and Organizational Development |
| K406 | New Tracks and Track Renewal |
| K407 | Structures |
| K407a | Bridges |
| K407b | Tunnels |
| K407c | Stations |
| K408 | Terminals and Yards |
| K409 | Signaling Systems |
| K410 | Rolling Stock |
| K410a | Locomotives |
| K410b | Other |
| K411 | Electrification |
| K412 | Rail Operations |
| K413 | Workshops and Equipment Maintenance |
| K414 | Track Maintenance |
| K415 | Computer Applications |
| K415a | Information Systems |
| K415b | Analysis, Planning and Forecasting |
| K415c | Operations |
| Other (Specify) | |
| K416 | |
| K417 | |
| K418 | |
| For additional RAIL TRANSPORTATION fields of Specialization, see: TE – TELECOMMUNICATIONS SECTOR code I401... (page 42) | |
| K500 | Seaports and River Ports |
| K501 | Demand Forecasting and Investment Planning |
| K502 | Financial Analysis, Costing and Tariffs |
| K503 | Management and Organizational Development |
| K504 | Harbors, Piers, Wharves |
| K505 | Port Maintenance |
| K506 | Dredging and Reclamation |
| K507 | Port Operations |
| K508 | Warehouses and Storage |
| K509 | Bulk Cargo Handling Facilities |
| K510 | Offshore Facilities |
| K511 | Deep Sea Ports |
| K512 | Container Ports |
| K513 | Bulk (Wet and Dry) Ports |
| K514 | Cargo Handling Operations |

**PART B. FIRM CAPABILITY**
**FIELDS OF SPECIALIZATION**

## TR – Transportation Sector

| CODES | FIELDS OF SPECIALIZATION |
|---|---|
| | Seaports and River Ports (cont.) |
| K515 | Navigation Aids |
| K516 | Computer Applications |
| K516a | Information Systems |
| K516b | Port Operations |
| Other (specify) | |
| K517 | |
| K518 | |
| K519 | |
| | *For additional SEAPORTS AND RIVER PORTS fields of specialization, see:* TE – TELECOMMUNICATIONS SECTOR code I404, (page 42) TR – TRANSPORTATION SECTOR code K203d, (page 46) |
| K600 | Shipping |
| K601 | National Shipping Fleets / Companies |
| K602 | Management and Operations |
| K603 | Financial Analyses |
| K604 | Vessels |
| K604a | Tankers, Bulk / General Cargo Vessels etc. |
| K604b | Coastal Shipping Vessels |
| K604c | Shipyards |
| K604d | Ferries |
| K605 | Shipbuilding and Repairing |
| K605a | Shipbuilding |
| K605b | Ship Maintenance and Repairing |
| K605c | Shipyards |
| K605d | Dry Docks |
| K605e | Floating Docks |
| K605f | Naval Architecture |
| K605g | Marine Engineering |
| Other (specify) | |
| K606 | |
| K607 | |
| K608 | |
| K700 | Inland Waterways |
| K701 | Demand Forecasting and Investment Planning |
| K702 | Management and Organizational Development |
| K703 | River Regulation and Control |
| K704 | Dredging and Reclamation |
| K705 | Navigation Locks and Dams |
| K706 | Canals |
| K707 | Ports |
| K708 | Jetties |
| K709 | Maintenance |
| K710 | Navigation Aids |
| K711 | Dockyards and Vessel Repair Facilities |
| K712 | Transportation Industry (Firm Services) |
| Other (specify) | |
| K713 | |
| K714 | |
| K715 | |
| K800 | Airports |
| K801 | Demand Forecasting and Investment Planning |
| K802 | Management and Organizational Development |

| CODES | FIELDS OF SPECIALIZATION |
|---|---|
| K803 | Financial Analysis, Costing and Charges |
| K804 | Site Selection and Land Use / Environmental Studies |
| K805 | Airport Layouts & Civil Works (Runways, Taxiways, Aprons etc. |
| K806 | Structures |
| K806a | Terminals |
| K806b | Warehouses and Freight Handling Facilities |
| K806c | Hangars, Workshops, etc. |
| K807 | Infrastructure |
| K807a | Fueling Facilities |
| K807b | Lighting |
| K807c | Other |
| K808 | Airport Maintenance |
| K809 | Airport Operations |
| K810 | Air Traffic Control |
| K811 | Navigational Aids |
| K812 | Airstrips (Low-Volume) |
| Other (specify) | |
| K813 | |
| K814 | |
| K815 | |
| | For additional AIRPORTS fields of specialization, see: TE – TELECOMMUNICATIONS SECTOR, code I402, (page 42) |
| | |
| K900 | Air Transportation Services |
| K901 | Air Craft Selection |
| K902 | Airline Management and Operations |
| K903 | Financial Analysis, Costing and Tariffs |
| K904 | Schedule Planning |
| K905 | Regulation |
| K906 | Pricing |
| K907 | Aircraft Maintenance |
| K908 | Computer Application |
| K908a | Airline Reservation System |
| K908b | Information System |
| K908c | Operations |
| Other (specify) | |
| K909 | |
| K910 | |
| K911 | |
| K1000 | Miscellaneous Transportation |
| K1001 | Conveyor Belts |
| K1002 | Cable Cars |
| Other (specify) | |
| K1003 | |
| K1004 | |
| K1005 | |
| | Urban Transportation |
| | *URBAN TRANSPORTATION fields of specialization are contained in the* UD – URBAN DEVELOPMENT SECTOR (pages 50 and 51) |
| | |
| | |
| | |

**PART B. FIRM CAPABILITY**
**FIELDS OF SPECIALIZATION**

## WS – Water Supply and Sanitation Sector

| | CODES | FIELDS OF SPECIALIZATION | | CODES | FIELDS OF SPECIALIZATION |
|---|---|---|---|---|---|
| | M100 | Water Supply | | *For additional SOLID WASTE fields of specialization, see* UD – URBAN DEVELOPMENT SECTOR code L302c. (page 50) | |
| | M101 | Water System Panning and Design | | | |
| | M102 | Water Resources Development | | M400 | Water Supply and Sanitation Management |
| | M102a | Groundwater | | M401 | Requirements Forecasting |
| | M102b | Surface water | | M402 | Financial Planning |
| | M103 | Water Quality | | M403 | Organization and Management |
| | M104 | Source Reservoirs | | M404 | Rates and Tariffs |
| | M105 | Dams | | M405 | Water Metering |
| | M106 | Tunnels | | M406 | Accounting / Auditing Systems |
| | M107 | Submarine Pipelines | | M407 | Computerization |
| | M108 | Water Transmission | | M408 | Legislation |
| | M109 | Pumping Stations | | M409 | Rural Water Supply and Sanitation Management |
| | M110 | Water Storage | | Other (specify) | |
| | M111 | Water Treatment | | M410 | |
| | M112 | Water Distribution | | M411 | |
| | M113 | System Rehabilitation and Upgrading | | M412 | |
| | M114 | Desalination | | | |
| | M115 | Corrosion | | | |
| | M116 | Leak Detection | | | |
| | M117 | Rural Water Supplies | | | |
| | Other (Specify) | | | | |
| | M118 | | | | |
| | M119 | | | | |
| | M120 | | | | |
| | M200 | Sanitation | | | |
| | M201 | Sewage Collection Systems | | | |
| | M202 | Sewage Treatment | | | |
| | M202a | Domestic | | | |
| | M202b | Industrial | | | |
| | M203 | System Rehabilitation and Upgrading | | | |
| | M204 | Stabilization Ponds | | | |
| | M205 | Marine Disposal | | | |
| | M206 | Land Application | | | |
| | M207 | Low - Cost Urban Sanitation | | | |
| | M208 | Storm Drainage | | | |
| | M209 | Rural Sanitation | | | |
| | M210 | Water Pollution Control | | | |
| | M211 | Water Recycling and Re-use | | | |
| | M212 | Sludge Recycling and Re-use | | | |
| | M213 | Resource Recovery | | | |
| | Other (specify) | | | | |
| | M214 | | | | |
| | M215 | | | | |
| | M216 | | | | |
| | M300 | Solid Waste | | | |
| | M301 | Collection and Logistics | | | |
| | M302 | Disposal | | | |
| | M303 | Resource Recovery | | | |
| | Other (specify) | | | | |
| | M304 | | | | |
| | M305 | | | | |
| | M306 | | | | |

## PART C. FIRM EXPERIENCE

## 19. COUNTRIES

19. Countries in Which Firm/Entity is Working Now or Has Worked in the Past 5 Years (check appropriate spaces)

| | CODES | COUNTRIES | | CODES | COUNTRIES | | CODES | COUNTRIES |
|---|---|---|---|---|---|---|---|---|
| | AF | Afghanistan | | GRD | Grenada | | PNG | Papua New Guinea |
| | ALB | Albania | | GU | Guatemala | | PA | Paraguay |
| | AL | Algeria | | GUI | Guinea | | PE | Peru |
| | ANG | Angola | | GUB | Guinea - Bissau | | PH | Philippines |
| | AR | Argentina | | GUA | Guyana | | POL | Poland |
| | AU | Australia | | HA | Haiti | | PO | Portugal |
| | AUA | Austria | | HO | Honduras | | QA | Qatar |
| | BM | Bahamas | | HK | Hong Kong | | RC | Romania |
| | BH | Bahrain | | HUN | Hungary | | RW | Rwanda |
| | BD | Bangladesh | | IC | Iceland | | STP | Sao Tome and Principe |
| | BAR | Barbados | | IN | India | | SAU | Saudi Arabia |
| | BE | Belgium | | IND | Indonesia | | SE | Senegal |
| | BEN | Benin | | IRN | Iran | | SEY | Seychelles |
| | BHU | Bhutan | | IRQ | Iraq | | SL | Sierra Leone |
| | BO | Bolivia | | IRE | Ireland | | SI | Singapore |
| | BT | Botswana | | IS | Israel | | SOL | Solomon Islands |
| | BR | Brazil | | IT | Italy | | SO | Somalia |
| | BUL | Bulgaria | | IVC | Ivory Coast | | SA | South Africa |
| | BA | Burma | | JM | Jamaica | | SP | Spain |
| | BU | Burundi | | JA | Japan | | CE | Sri Lanka |
| | BYE | Byelorussia | | JO | Jordan | | SU | Sudan |
| | CM | Cameron | | KH | Kampuchea | | SUR | Suriname |
| | CAN | Canada | | KE | Kenya | | SW | Swaziland |
| | CV | Cape Verde | | KO | Korea | | SWE | Sweden |
| | CA | Central African Empire | | KU | Kuwait | | SWI | Switzerland |
| | CD | Chad | | LA | Laos | | SYR | Syria |
| | CH | Chile | | LE | Lebanon | | TA | Tanzania |
| | CHN | China, People's Republic of | | LSO | Lesotho | | TH | Thailand |
| | CHA | China, (Taiwan) Republic of | | LBR | Liberia | | TO | Togo |
| | CO | Columbia | | LBY | Libya | | TR | Trinidad and Tobago |
| | COM | Comoros | | LU | Luxembourg | | TUN | Tunisia |
| | COB | Congo | | MAG | Madagascar | | TU | Turkey |
| | CR | Costa Rica | | MAI | Malawi | | UG | Uganda |
| | CUB | Cuba | | MA | Malaysia | | UKR | Ukraine |
| | CY | Cyprus | | MAL | Maldives | | USS | Union of Soviet Socialist Republics |
| | CZE | Czechoslovakia | | MLI | Mali | | UAE | United Arab Emirates |
| | DE | Denmark | | MAT | Malta | | UK | United Kingdom |
| | DI | Djibouti | | MAU | Mauritania | | USA | United States |
| | DO | Dominican Republic | | MAS | Mauritius | | UV | Upper Volta |
| | EC | Ecuador | | ME | Mexico | | UR | Uruguay |
| | EGT | Egypt | | MNG | Mongolia | | VE | Venezuela |
| | ES | El Salvador | | MOR | Morocco | | VN | Vietnam |
| | EG | Equatorial Guinea | | MOZ | Mozambique | | WSO | Western Samoa |
| | ET | Ethiopia | | NEP | Nepal | | YAR | Yemen Arab Republic |
| | FIJ | Fiji | | NE | Netherlands | | YDR | Yemen, Democratic Republic of |
| | FI | Finland | | NZ | New Zealand | | YU | Yugoslavia |
| | FR | France | | NI | Nicaragua | | ZR | Zaire |
| | GA | Gabon | | NIR | Niger | | ZA | Zambia |
| | GM | Gambia | | UNI | Nigeria | | Other (Specify) | |
| | GDR | Germany, Democratic Republic of | | NO | Norway | | XX | |
| | WEG | Germany, Federal Republic of | | OM | Oman | | YY | |
| | GH | Ghana | | PAK | Pakistan | | ZZ | |
| | GR | Greece | | PAN | Panama | | | |

## PART C. FIRM EXPERIENCE
## 20. PROJECT / SERVICES

| 20. Projects for Which Firm/Entry is Providing Services Now or Has Provided Services in the Past 5 Years (see Explanation for item 20, page 58) | | |
|---|---|---|
| a. Project Description Sheet No | b. No. of Similar Projects for which Firm/Entity Provided Similar Services | c. Sector(s) in which Firm Entity Provided Services on this Project (use code(s) from item 18, Page 9, e.g. AG. CO, ED...) |

### DATA ON OVERALL PROJECT

| d. Project Name | | | | e. Project Country (use code from item 19, page 59) |
|---|---|---|---|---|
| f. Project Location Within Country (name of nearest town or city, or name of region) | | | g. Approximate Project Value in US$ millions to 2 decimal places (0000.00) | |
| h. Short Project Description (maximum of 75 characters) | | | | |
| i. International Regional /Bilateral Institutions Financing Project (use acronyms) | | | | |
| Loan or Credit No. (if known) Cross out L or C, whichever does not apply) | L/C | L/C | L/C | L/C |

### DATA ON SERVICES PROVIDED BY YOUR FIRM/ENTITY

| j. Name of Client | | | | k. No. of Professional Manmonths of Services Provided[1] |
|---|---|---|---|---|
| l. Start Date[1] (month/year) / | m. Completion Date[1] (month/year) / | | n. Approximate Value of Services[1] (in US$) millions to 2 decimal places) (00.00) | |
| o. Types of Services Provided[1] (use codes from item 17, pages 11 to 13, e. g... 1a, 2b, 4e...) | | | | |
| p. Fields of Specialization to which Services were Provided[1] (use codes from item 18, pages 16 to 56, e.g. A101, A1204, A2103A...) | | | | |
| q. Services Provided in Joint Venture or Association with: (full name) | | | | Acronym (if any) |
| | | | | |
| | | | | |
| r. International Regional Bilateral Institutions Financing Services Provided (use acronyms) | | | | |
| Loan or Credit No (if known) (cross out L or C whichever does not apply) | L/C | L/C | L/C | L/C |

### NARRATIVE DESCRIPTION OF PROJECT AND SERVICES PROVIDED (OPTICAL)

| s. Narrative Description of Project and Services Provided (OPTIONAL) (check this space if Narrative Description of Project and Services Provided is included) ☐ |
|---|
| |

**ATTACHMENT 1**

**NARRATIVE DESCRIPTION**

| NARRATIVE DESCRIPTION OF FIRM/ENTITY |
| --- |
| |

**ATTACHMENT 2**

**PARTNERS, DIRECTORS, OFFICERS AND KEY PERSONNEL**

| PARTNERS, DIRECTORS, OFFICERS AND KEY PERSONNEL OF FIRM/ENTITY | | | | |
|---|---|---|---|---|
| Name and Title | Degree(s) Diploma(s) | Working Language(s) | Years With Firm | Year of Birth |
| | | | | |

**ATTACHMENT 3**

**OWNERSHIP AND NATIONALITY**

| OWNERSHIP AND NATIONALITY OF FIRM/ENTITY |
| --- |
| |

**ATTACHMENT 4**

**BRANCH OFFICE ADDRESSES**

| ADDRESSES OF BRANCH OFFICES OF FIRM/ENTITY, OUTSIDE HOME COUNTRY | | | |
|---|---|---|---|
| Country Code [1] | Full Firm Name | | Acronym (if any) |
| | Street Address | | Telephone No. |
| | City, Country | | Cable Address |
| | P.O. Box (if any) | State/Province | Telex No. |
| | Postal Code | Country | Year Established |
| | Person in Charge (name, title) | | |

| | | | |
|---|---|---|---|
| Country Code [1] | Full Firm Name | | Acronym (if any) |
| | Street Address | | Telephone No. |
| | City, Country | | Cable Address |
| | P.O. Box (if any) | State/Province | Telex No. |
| | Postal Code | Country | Year Established |
| | Person in Charge (name, title) | | |

| | | | |
|---|---|---|---|
| Country Code [1] | Full Firm Name | | Acronym (if any) |
| | Street Address | | Telephone No. |
| | City, Country | | Cable Address |
| | P.O. Box (if any) | State/Province | Telex No. |
| | Postal Code | Country | Year Established |
| | Person in Charge (name, title) | | |

****U.S. General Services Administration - Standard Form SF-254, and 255 ****

STANDARD FORM (SF)
**254**
Architect-Engineer And Related Services Questionnaire

1. Firm Name / Business Address

1a. Submittal is for ☐ Parent Company ☐ Branch or Subsidiary Office

2. Year Present Firm Established

3. Date Prepared

4. Specify of ownership *and* check below, *if* applicable.1

- A. Small Business
- B. Small Disadvantaged Business
- C. Woman-owned Business

5. Name of Parent Company, *if* any:

5a. Former Parent Company Name(s), *if* any, and Year(s) Established:

6. Names of not more than Two Principals to Contact: Title / Telephone
1)
2)

7. Present Offices: City / State / Telephone / No. Personnel Each Office

7a. Total Personnel _____

8. Personnel by Discipline: *(List each person only once, by primary function)*

___ Administrative
___ Architects
___ Chemical Engineers
___ Civil Engineers
___ Construction Inspectors
___ Draftsmen
___ Ecologists
___ Economists
___ Electrical Engineers
___ Estimators
___ Geologists
___ Hydrologists
___ Interior Designers
___ Landscape Architects
___ Mechanical Engineers
___ Mining Engineers
___ Oceanographers
___ Planners: Urban Regional
___ Sanitary Engineers
___ Soils Engineers
___ Specification Writers
___ Structural Engineers
___ Surveyors
___ Transportation Engineers
_____
_____
_____
_____
_____
_____
_____
_____

9. Summary of Professional Services Fees
Received: (Insert Index Number)

| | Last 5 Years (most recent year first) 19____ | 19____ | 19____ | 19____ | 19____ |
|---|---|---|---|---|---|
| Direct Federal contract work, including overseas | | | | | |
| All other domestic work | | | | | |
| All other foreign work | | | | | |

*Firms interested in foreign work, but without such experience, check here: ☐

Ranges of Professional Services Fees
INDEX
1. Less than $100,000
2. $100,000 to $250,000
3. $250,000 to $500,000
4. $500,000 to $1 million
5. $1 million to $2million
6. $2 million to $5 million
7. $5 million to $10million
8. $10 million or greater

10. Profile of Firm's Project Experience, Last 5 Years

| Profile Code | Number of Projects | Total Gross Fees (In thousands) | Profile Code | Number of Projects | Total Gross Fees (In thousands) | Profile Code | Number of Projects | Total Gross Fees (In thousands) |
|---|---|---|---|---|---|---|---|---|
| 1) | | | 11) | | | 21) | | |
| 2) | | | 12) | | | 22) | | |
| 3) | | | 13) | | | 23) | | |
| 4) | | | 14) | | | 24) | | |
| 5) | | | 15) | | | 25) | | |
| 6) | | | 16) | | | 26) | | |
| 7) | | | 17) | | | 27) | | |
| 8) | | | 18) | | | 28) | | |
| 9) | | | 19) | | | 29) | | |
| 10) | | | 20) | | | 30) | | |

11. Project Examples, Last 5 Years

| Profile Code | "P", "C" "JV", or "E" | Project Name and Location | Owner Name and Address | Cost of Work (In thousands) | Completed Date (Actual Estimated) |
|---|---|---|---|---|---|
| | | 1 | | | |
| | | 2 | | | |
| | | 3 | | | |
| | | 4 | | | |
| | | 5 | | | |
| | | 6 | | | |
| | | 7 | | | |

| | | | | | |
|---|---|---|---|---|---|
| | | 8 | | | |
| | | 9 | | | |
| | | 10 | | | |
| | | 11 | | | |
| | | 12 | | | |
| | | 13 | | | |
| | | 14 | | | |
| | | 15 | | | |
| | | 16 | | | |
| | | 17 | | | |
| | | 18 | | | |
| | | 19 | | | |
| | | 20 | | | |
| | | 21 | | | |
| | | 22 | | | |
| | | 23 | | | |
| | | 24 | | | |
| | | 25 | | | |
| | | 26 | | | |
| | | 27 | | | |
| | | 28 | | | |
| | | 29 | | | |
| | | 30 | | | |
| 12. The foregoing is a statement of facts<br><br>Signature: _____ Type Name and Title _____ | | | | Date: | |

| STANDARD FORM (SF) **255** Architect-Engineer Related Services for Specific Project | 1. Project Name / Location for which Firm is Filing: | 2a. Commerce Business Daily Announcement Date, if any: | 2b. Agency Identification Number, if any: |
|---|---|---|---|

| 3. Firm (or Joint – Venture) Name and Address | 3a. Name, Title & Telephone Number of Principal to Contact |
|---|---|
| | 3b. Address of office to perform work, if different from item 3 |

4. Personnel by Discipline: (List each person only once, by primary function)

| | | | |
|---|---|---|---|
| ___ Administrative | ___ Electrical Engineers | ___ Oceanographers | _____ |
| ___ Architects | ___ Estimators | ___ Planners: Urban Regional | _____ |
| ___ Chemical Engineers | ___ Geologists | ___ Sanitary Engineers | _____ |
| ___ Civil Engineers | ___ Hydrologists | ___ Soils Engineers | _____ |
| ___ Construction Inspectors | ___ Interior Designers | ___ Specification Writers | _____ |
| ___ Draftsmen | ___ Landscape Architects | ___ Structural Engineers | _____ |
| ___ Ecologists | ___ Mechanical Engineers | ___ Surveyors | _____ |
| ___ Economists | ___ Mining Engineers | ___ Transportation Engineers | _____ Total Personnel |

5. If submittal is by JOINT – VENTURE list participating firms and outline specific areas of responsibility (including administrative, technical and financial) for each firm: (Attach SF 254 for each if not on file with Procuring Office )

5a. Has this Joint – Venture previously worked together? ☐ Yes No ☐

6. If respondent is not a joint – venture, list Outside key Consultant / Associates anticipated for this project (Attach SF 254 for Consultants / Associates listed. If not already on file with the Contracting Office.)

| Name and Address | Specialty | Worked with Prime before (Yes or No) |
|---|---|---|
| 1) | | |
| 2) | | |
| 3) | | |
| 4) | | |
| 5) | | |
| 6) | | |
| 7) | | |
| 8) | | |

| 7 Brief resume of key persons, specialist, and individual consultants anticipated for this project. | |
|---|---|
| a. Name & Title: | a. Name & Title: |
| b. Project Assignment: | b. Project Assignment: |
| c. Name of Firm with which associated: | c. Name of Firm with which associated: |
| d. Years experience: With this Firm ____ With other Firms ____ | d. Years experience: With this Firm ____ With other Firms ____ |
| e. Education Degree(s) / Year / Specialization | e. Education Degree(s) / Year / Specialization |
| f. Active Registration: Year First Registered / Discipline | f. Active Registration: Year First Registered / Discipline |
| g. Other experience and Qualifications relevant to the proposed project: | g. Other experience and Qualifications relevant to the proposed project: |

8. Work by firm or joint – venture members which best illustrates current qualifications relevant to this project (list not more than 10 projects.)

| a. Project Name & Location | b. Nature of Firm's Responsibility | c. Project Owner's Name & Address | d. Completion Date (actual or estimated) | e. Estimated Cost (in thousands) | |
|---|---|---|---|---|---|
| | | | | Entire Project | Work for which Firm was / is Responsible |
| (1) | | | | | |
| (2) | | | | | |
| (3) | | | | | |
| (4) | | | | | |
| (5) | | | | | |
| (6) | | | | | |
| (7) | | | | | |
| (8) | | | | | |
| (9) | | | | | |
| (10) | | | | | |

9. All work by firms or joint – venture members currently being performed directly for Federal agencies.

| a. Project Name & Location | b. Nature of Firm's Responsibility | c. Agency (Responsible Office) Name & Address | d. Percent Complete | e. Estimated Cost (in thousands) | |
|---|---|---|---|---|---|
| | | | | Entire Project | Work for which Firm is Responsible |
| | | | | | |

10. Use this space to provide any additional information or description of resources (including any computer design capabilities) supporting your firms qualifications for the proposed project.

11. The foregoing is a statement of facts

Signature: _____ Type Name and Title _____

Date:

# APPENDIX – D -

## The Questionnaire Forms (I, II, III)

May 17, 1997

TO WHOM IT MAY CONCERN

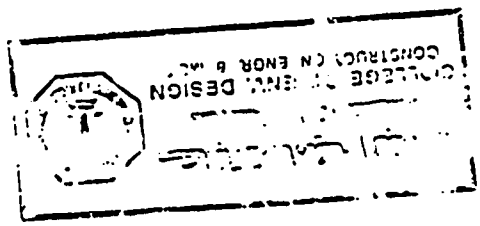
Dear Sir,

Mr. Mubarak Al-Besher is a graduate student in the CEM Department. He is conducting a research on Consultant Prequalification and Selection.

The department has put a lot of faith on your contribution to this study. The success of the study depends on your participation. I shall appreciate your help by providing the student with some information related to the above topic.

Thank you in advance for your positive cooperation.

Dr. M. Osama Jannadi
Chairman
Construction Engineering & Management Dept.



January 14, 1998

Dear Sir,

We are currently, at King Fahd University of Petroleum and Minerals, conducting a research in the area of consultant's prequalification and selection process in the Kingdom of Saudi Arabia. The aims of this research are to identify the important consultant's selection criteria, and to develop a selection model that will help those involve in consultant's prequalification and selection to a better understanding of what specific criteria should be utilized. The research will help toward improved evaluation process to arrive to successful final selection "selecting the most qualified consultant (A/E)".

A copy of the simple questionnaire for the consultant's selection criteria and selection methods is enclosed. Filling this form may not take more than 10 minutes of your valuable time. The provided information shall be used for academic purposes only. We believe that your participation is vital to the success of this research which is intended to the improvement of the consultant's engagement, and provide the needed helps to those concerned parties participating in the consultants' prequalification and selection process in Saudi Arabia.

Kindly return the completed questionnaire form by mail or fax to the following address:

Mubarak F. Al-Besher
King Fahd Military City
P. O. Box 33165
Dammam, 31448, Saudi Arabia

If you need and any further information, please contact Mubarak Al-Besher at Telephone (03) 8403239 (03) 8440723 or Fax: (03) 8403337 (03) 8440538

Thank you for your valuable cooperation.

Mubarak Al-Besher
Graduate Student

# Consultant's selection Criteria

## Questionnaire Part I:

Please circle to rate the following criteria in term of importance of consultant selection on scale of one to nine. Where one (1) is the least important, and nine (9) is the extremely important.

### I. A/E Selection Criteria

| A/E SELECTION CRITERIA | RATING ( 1- least important, 9- extremely important ) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1. Current Work Load | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 2. Experience | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 3. Experience in Geographical Area | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 4. Financial Stability | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 5. Firm Capacity | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 6. Firm Organization | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 7. Head Office Location | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 8. Past Performance | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 9. Project Management Capability | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 10. Quality Performance | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 11. References | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 12. Staff and / Qualification. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 13. Quality assurance/ Control | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 14. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 15. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 16 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 17. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| Are there any other criteria that you evaluate during the selection process? If so list them and check the appropriate rating. | | | | | | | | | |

**Questionnaire Part II** Pairwise Comparison Matrix "A/Es As Compared By Public Sector With Respect To Criteria"

| Criteria | A/E1 | A/E2 | A/E3 | A/E4 | A/E5 |
|---|---|---|---|---|---|
| **A/E1** | 1 | | | | |
| **A/E2** | | 1 | | | |
| **A/E3** | | | 1 | | |
| **A/E4** | | | | 1 | |
| **A/E5** | | | | | 1 |

**Questionnaire Part III** Pairwise Comparison Matrix "Criteria as Compared by Public Sector" With Respect to Goal

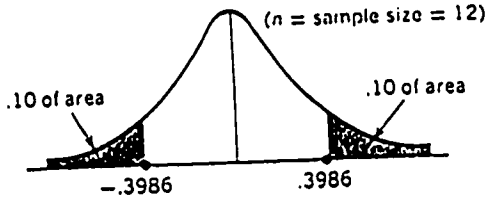
| Goal | CR.1WEXP | CR2.FCAP | CR.3PPER | CR.4REFS | CR.5PRMC | CR.6QPER | CR.7SQ | CR.8QC |
|---|---|---|---|---|---|---|---|---|
| CR.1WEXP | 1 | | | | | | | |
| CR2.FCAP | | 1 | | | | | | |
| CR.3PPER | | | 1 | | | | | |
| CR.4REFS | | | | 1 | | | | |
| CR.5PRMC | | | | | 1 | | | |
| CR.6QPER | | | | | | 1 | | |
| CR.7SQ | | | | | | | 1 | |
| CR.8QC | | | | | | | | 1 |

# APPENDIX – E –

## Values of Spearman Rank Correlation ($r_s$)

# Appendix -E- Values of Spearman Rank Correlation ($r_s$) for Combined Area in Both Tails.

Values for Spearman's Rank Correlation ($r_s$) for Combined Areas in Both Tails.*




EXAMPLE: For a two-tailed test of significance at the .20 level, with $n = 12$, the appropriate value for $r_s$ can be found by looking under the .20 column and proceeding down to the 12 row; there we find the appropriate $r_s$ value to be .3986.

| n | .20 | .10 | .05 | .02 | .01 | .002 |
|---|---|---|---|---|---|---|
| 4 | .8000 | .8000 | | | | |
| 5 | .7000 | .8000 | .9000 | 9000 | | |
| 6 | .6000 | .7714 | .8286 | .8857 | .9429 | |
| 7 | .5357 | .6786 | .7450 | .8571 | .8929 | .9643 |
| 8 | .5000 | .6190 | .7143 | .8095 | .8571 | .9286 |
| 9 | .4667 | .5833 | .6833 | .7667 | .8167 | .9000 |
| 10 | .4424 | .5515 | .6364 | .7333 | .7818 | .8667 |
| 11 | .4182 | .5273 | .6091 | .7000 | .7455 | .8364 |
| 12 | .3986 | .4965 | .5804 | .6713 | .7273 | .8182 |
| 13 | .3791 | .4780 | .5549 | .6429 | .6978 | .7912 |
| 14 | .3626 | .4593 | .5341 | .6220 | .6747 | .7670 |
| 15 | .3500 | .4429 | .5179 | .6000 | .6536 | .7464 |
| 16 | .3382 | .4265 | .5000 | .5824 | .6324 | .7265 |
| 17 | .3260 | .4118 | .4853 | .5637 | .6152 | .7083 |
| 18 | .3148 | .3994 | .4716 | .5480 | .5975 | .6904 |
| 19 | .3070 | .3895 | .4579 | .5333 | .5825 | .6737 |
| 20 | .2977 | .3789 | .4451 | .5203 | .5684 | .6586 |
| 21 | .2909 | .3688 | .4351 | .5078 | .5545 | .6455 |
| 22 | .2829 | .3597 | .4241 | .4963 | .5426 | .6318 |
| 23 | .2767 | .3518 | .4150 | .4852 | .5306 | .6186 |
| 24 | .2704 | .3435 | .4061 | .4748 | .5200 | .6070 |
| 25 | .2646 | .3362 | .3977 | .4654 | .5100 | .5962 |
| 26 | .2588 | .3299 | .3894 | .4564 | .5002 | .5856 |
| 27 | .2540 | .3236 | .3822 | .4481 | .4915 | .5757 |
| 28 | .2490 | .3175 | .3749 | .4401 | .4828 | .5660 |
| 29 | .2443 | .3113 | .3685 | .4320 | .4744 | .5567 |
| 30 | .2400 | .3059 | .3620 | .4251 | .4665 | .5479 |

# APPENDIX – F –

****List of Public Sector Organizations and Consultants for the Survey****

# LIST OF GOVERNMENT AGENCIES

| NO | PUBLIC SECTOR AGENCY | LOCATION |
|---|---|---|
| 1. | National Guard Presidency | RIYADH |
| 2. | Presidency of Youth Welfare | RIYADH |
| 3. | Eastern Water Department | DAMMAM |
| 4. | Royal Commission for Jubail & Yanbu | JUBAIL |
| 5. | Ministry of Defense & Aviation/ GDMW | RIYADH |
| 6. | Ministry of the Interior | RIYADH |
| 7. | Ministry of Municipal & Rural Affairs | RIYADH |
| 8. | Ministry of Public Works & Housing | RIYADH |
| 9. | Riyadh Municipality | RIYADH |
| 10. | Ministry of Defense/ Air Force ENG'R DEPT. | RIYADH |
| 11. | Ministry of Defense/ Navy ENG'R DEPT. | RIYADH |
| 12. | Ministry of Health | RIYADH |
| 13. | Ministry of Information | RIYADH |
| 14. | Presidency of Girls Education | RIYADH |
| 15. | Ministry of Communications | RIYADH |
| 16. | Railroad Organization | RIYADH |
| 17. | Ministry of Post, Telephone, and Telegraph | RIYADH |
| 18. | Ministry of Petroleum & Mineral Resources | RIYADH |
| 19. | Ministry of Industry & Electricity | RIYADH |
| 20. | Ministry of Agriculture & Water | RIYADH |
| 21. | General Organization of Desalination | RIYADH |
| 22. | Ministry of Pilgrims & Endowments | RIYADH |
| 23. | Ministry of Finance and National Economy | RIYADH |
| 24. | Ministry of Education | RIYADH |
| 25. | Ministry of higher Education | RIYADH |
| 26. | Ministry of Planning | RIYADH |
| 27. | Ministry of Defense/ O&M DEPTS. | RIYADH |
| 28. | Ministry of Defense/ Air Defense ENG'R DEPT. | RIYADH |
| 29. | Riyadh City Water Department | RIYADH |
| 30. | Dammam Municipality | DAMMAM |

## CONSULTANTS SAMPLES IN DAMMAM, & RIYADH:

| NO. | CONSULTANT NAME | LOCATION | PHONE |
|---|---|---|---|
| 1 | Saudi Engineering Group International | Dammam | 8333060 |
| 2 | Al-Qatari Consultants | Dammam | 8541014 |
| 3 | Ahmad Al-Mousa Engineering Consultants | Dammam | 8348883 |
| 4 | Dar Hejles Engineering Consultants | Qatif | 8556697 |
| 5 | Consulting and Design Engineering | Khobar | 8952844 |
| 6 | Saudi Consulting and Design Office | Khobar | 8949001 |
| 7 | Engineering Design and Supervision Office | Khobar | 8943022 |
| 8 | Al-Awami Planner and Consultants | Qatif | 8551006 |
| 9 | Saudi Consultancy Services Office | Khobar | 8955004 |
| 10 | Gulf Group Consultants | Dammam | 8335783 |
| 11 | Al-Safi Engineering Office | Dammam | 8344436 |
| 12 | Al-Mulla Engineering Office | Dammam | 8335170 |
| 13 | Arabian Survey Center | Dammam | 8348305 |
| 14 | Sir Bruce White, Wolfe Barry and Partners | Dammam | 8332691 |
| 15 | Rashid Geotech'al and Material Engineering | Khobar | 8982240 |
| 16 | AL – Otaisshan Engineering Office. | RIYADH | 4652841 |
| 17 | Al –Anizi Engineering Office | RIYADH | 2327463 |
| 18 | Saudi Projacs | RIYADH | 4658562 |
| 19 | A.AL-Namlah for Archet.Engineering | RIYADH | 4922111 |
| 20 | F.Al-Saleh Engineering Office | RIYADH | 4640345 |
| 21 | Fahd Al-Moajil Engineering Office | RIYADH | 4567238 |
| 22 | M.Al-Moamen for Project Managements | RIYADH | 2300760 |
| 23 | A&A AB-Al-Khail Engineering | RIYADH | 4641398 |
| 24 | A.A. Aal- Shaikh Engineering Office | RIYADH | 4625018 |
| 25 | Abdulaziz for Project Management | RIYADH | 4649020 |
| 26 | DR. Amad Engineering Office | RIYADH | 4773950 |
| 27 | Abdulrahman Engineering Office | RIYADH | 4787691 |
| 28 | Saudi Designer for Archetcture | RIYADH | 4420088 |
| 29 | A. S. Al Hejailan for Engineering Designs | RIYADH | 4629358 |
| 30 | Ahmad Al Faiz for Engineering | RIYADH | 4776385 |
| | | | |

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# IMAGE EVALUATION
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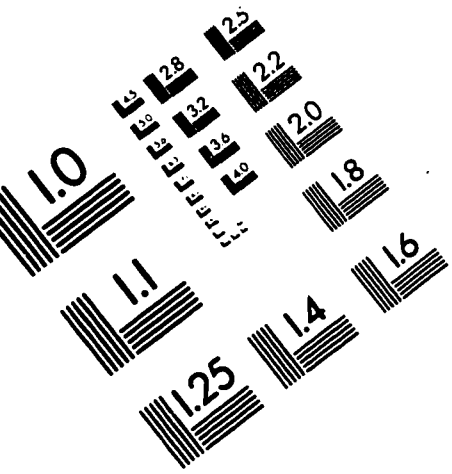


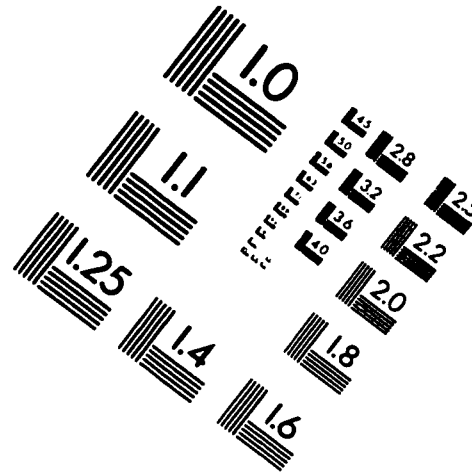


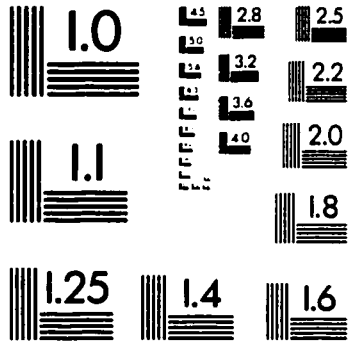


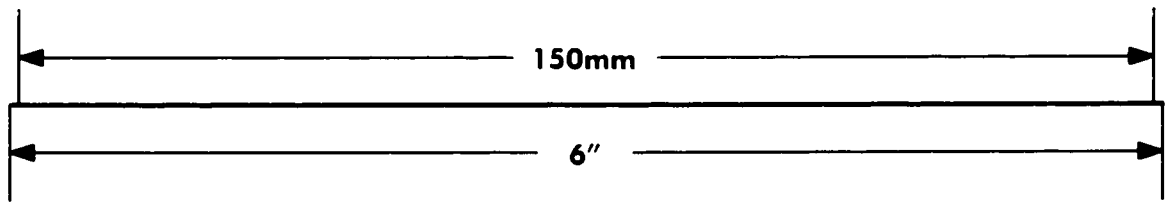


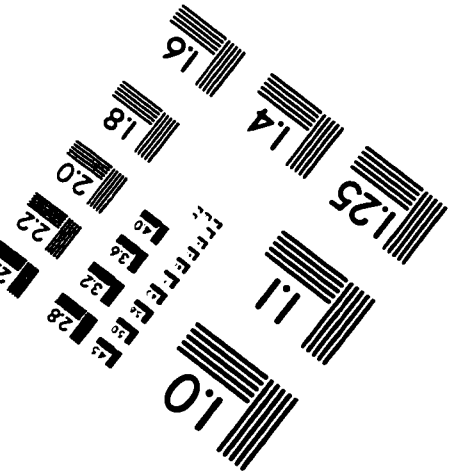


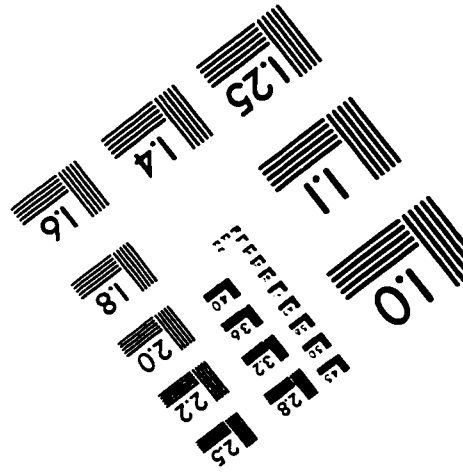


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